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CONTENTS

THE DISTRIBUTION, MORPHOLOGY AND RELATIONSHIP OF THE CARANGID FISH, *Trachurus lathami* NICHOLS. *By Daniel Merriman* 205

THE LUTIANID FISHES OF TEXAS. *By J. L. Baughman* 212

A NEW PHILIPPINE APOGONID WITH NOTES ON SOME RARE SPECIES. *By Albert W. C. T. Herre* 216

THE EARLY EMBRYOLOGY OF *Platypoecilus maculatus*. *By Arthur F. Hopper, Jr.* .. 218

OBSERVATIONS ON THE LIFE HISTORY OF THE BRAZILIAN FROG *Oocormus microps*. *By Bertha Lutz* 225

A NEW FROG FROM PALESTINE. *By Heinrich Mendelssohn and Heinz Steinitz* 231

NOTES ON JAMAICAN AMPHIBIANS. *By W. Gardner Lynn and James N. Dent* 234

FIELD NOTES ON A RED RATTLESNAKE IN LOWER CALIFORNIA. *By Lloyd Trevis, Jr.*... 242

THE "RELEASE" MECHANISM AND SEX RECOGNITION IN *Hyla andersonii*. *By Lester R. Aronson* 246

HERPETOLOGICAL NOTES—*Pseudemys scripta troostii* in Michigan, *by Richard A. Edgren, Jr.*: 249.—Notes on Reptiles from Mexico, *by Hobart M. Smith*: 250.—The Validity of *Crotalus viridis decolor* Klauber, *by Hobart M. Smith*: 251.—Notes on Amphibia of the Cascade Mountains in Oregon, *by Fred G. Evenden, Jr.*: 251.—*Haldea v. valeriae* in New Jersey, *by James Kezer and Harold Trapido*: 252.

ICHTHYOLOGICAL NOTES—*Notropis mearnsi* from Arizona, an Addition to the Known Fish Fauna of the United States, *by Robert R. Miller and James R. Simon*: 253.—Record of an "Albino" Lake Trout, *Cristivomer namaycush namaycush* (Walbaum), *by Albert S. Hazzard*: 253.—A Colorless Southern Flounder, *Paralichthys lethostigma* Jordan and Gilbert, from Texas, *by Gordon Gunter*: 254.—Unusual Spawning Habitat for the Common White Sucker, *Catostomus c. commersonnii, by Edward C. Raney*: 256.—Atlantic Salmon in Lake Jesse, Nova Scotia, *by M. W. Smith*: 257.—Two Neglected Names for a Sea-run Race of the Brook Trout of Eastern North America, *by Carl L. Hubbs*: 258.—Two Rare East Indian Carp, *by Albert W. C. T. Herre*: 258.—On Nesting of the White Crappie, *Pomoxis annularis, by Donald F. Hansen*: 259.—Terminology of Early Stages of Fishes, *by Carl L. Hubbs*: 260. .

REVIEWS AND COMMENTS—Protection of Coastal Fisheries under International Law: Stefan Riesenfeld, *by L. A. Walford*: 261.—International Agreements on Conservation of Marine Resources; Jozo Tomasevich, *by L. A. Walford*: 261.—The Oceans, their Physics, Chemistry, and General Biology: H. U. Iverdrup, Martin W. Johnson and Richard H. Fleming, *by L. A. Walford*: 261.—Joseph Grinnell's Philosophy of Nature: Selected Writings of a Western Naturalist, *by L. A. Walford*: 262.—Evolution the Modern Synthesis: Julian Huxley, *by Karl P. Schmidt*: 262.—On Your Own: How to Take Care of Yourself in Wild Country. A Manual for Field and Service Men; Samuel A. Graham and Earl C. O'Roke, *by Karl P. Schmidt*: 263.—Biology the Science of Life: Mary Stuart MacDougall, in collaboration with Robert Hegner, *by Karl P. Schmidt*: 263:—New Books Received: 264.

EDITORIAL NOTES AND NEWS—Walker Prize: 264.—John O. Snyder, by Carl L. Hubbs: 265.—News Notes: 266.—Errata: 266.

Index: 267.

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The Distribution, Morphology and Relationships of the Carangid Fish, *Trachurus lathami* Nichols

By Daniel Merriman

As pointed out by Nichols (1920 and 1940), the genus *Trachurus* is one of the most clearly differentiated of those which comprise the *Caranx*-like fishes. By contrast, the various species which are included in this genus are extremely difficult to separate, a fact which has led to frequent confusion, puzzling systematic treatment, and apparently faulty synonymy. However, only two forms of this genus are now generally recognized from the western Atlantic, *Trachurus lathami* and *Trachurus picturatus binghami*, respectively described by Nichols in the references cited above.

Trachurus lathami was the name given by Nichols (1920) for the form Jordan and Everman (1896) listed as *Trachurus trachurus*, with type locality the Mediterranean and range "North Atlantic chiefly on the coasts of Europe, south of Spain and Naples; it is very rare on our coasts, recorded from Newport, R. I., Pensacola, and Cape San Lucas." Nichols separated this species mainly on the basis of the fact that the accessory lateral line stops under the front of the soft dorsal instead of, as Lütken (1880) had emphasized for the European form, continuing further back. Jordan, Evermann, and Clark (1930), nevertheless, list both *Trachurus trachurus* and *Trachurus lathami* from the east coast, and Meek and Hildebrand (1925) speak of *Trachurus trachurus* and cite Nichols (*loc. cit.*) in a footnote.

The present paper is based on a single specimen of the rough scad, *Trachurus lathami* Nichols, which was taken on October 7, 1941, at the mouth of the Parker River, near Newburyport, Massachusetts, on rod and line. The precise distribution of this species is not well known. Nichols (1920) gives its range as: "Atlantic coast of America. Rare. Young numerous in the Gulf Stream off the Florida Keys (February 23, 1910)," while Jordan, Evermann, and Clark (1930) state: "Coast of Long Island (a stray from the Gulf Stream)," apparently taking their information from Nichols' statement that he examined three specimens from Orient, Long Island, New York. Nichols and Breder (1926) give one record of *T. lathami* from Newport, Rhode Island, and state that it is rare at Orient and accidental at New York; they speak of it being found "off the Atlantic coast of America..., adults probably along the western edge of the Gulf Stream." Breder (1929) says that it "occurs on our Atlantic coast as far north as Massachusetts." These are almost the only references to this species, and such standard works as Smith (1907), Bigelow and Welsh (1925), Hildebrand and Schroeder (1928), and Longley and Hildebrand (1941) list neither it nor *Trachurus trachurus*, although Meek and Hildebrand (1925) mention *T. trachurus* from Rhode Island.

The present record therefore constitutes a northern extension of the known range, and Mr. Nichols, who kindly identified the specimen in question, says (*in litt.*) that so far as he knows this fish has not been recorded

previously north of Cape Cod. Whether it occurs somewhat more commonly in the Gulf of Maine than the available information indicates and has simply escaped detection heretofore, whether its capture in these waters is truly "accidental," or whether the comparatively recent enlargement of the Cape Cod Canal has enabled it as well as other species to extend the northern limits of their ranges, can only be matters of conjecture. In regard to the first alternative, however, it should be mentioned that the novice may possibly find the key to the crevallys in Nichols and Breder (1927) misleading in regard to *Trachurus* where it states, "Lateral line with enlarged keeled scales on its entire length." Similarly Breder (1929), in his key to the Carangidae, speaks of the lateral line of *T. lathami* as "being armed with bony scutes for its entire length." When these scales in the specimen in question were examined under low magnification the "keeled" condition was not obvious over the whole extent of the lateral line. The keeled squamation was readily apparent on the posterior (straight) half of the lateral line; it was most prominent in the region of the caudal peduncle, but the actual keels became progressively less conspicuous anteriorly, and at the point where the anterior half of the lateral line started its curve toward the dorsal contour, they were relatively insignificant. From here on the scales of the chord remained enlarged and might be termed scutellate but could not be called truly keeled. Of the 70 scales in the lateral line, the anterior 33 lacked keels, while the posterior 37—all of which except the first three were on the straight part of the lateral line—were clearly keeled.

The standard length of this specimen was 103 mm. Its main taxonomic characters are listed below. Dorsal fin rays: VIII–I, 30. Anal fin rays, II–I, 28. Last ray of both soft dorsal and anal definitely enlarged and with relatively thick bases, but not separate or isolated from rest of fin (Breder, 1929); this condition is apparent in Plate I, A. Depth in length, 3.75; head, 3.55. Eye in head, 3.2; snout, 3.2. Pectoral fin in depth, 1.01. Curve of lateral line (chord) in straight part, 1.26. Gill rakers, 15 + 36 on first arch. Mouth moderate, scarcely reaching front of eye (see Plate I, A and B). Arch of lateral line barely extending beyond tip of pectoral. Upper accessory lateral line stopping abruptly under anterior end of soft dorsal. Peritoneum dusky, well pigmented with abundant melanophores. Considerable number of pyloric caeca present. In general the above characters agree well with those given by Nichols (1940), the only significant difference being the depth in length which is slightly below the lowest figure given by this author for individuals of this size category. The stomach and upper part of the intestine of the specimen in question were filled with the remains of small crustacea, and the body cavity contained several unidentified nematodes.

Little is known of the life history and growth rate of *Trachurus lathami*. Nichols (1940) believed that three specimens (B. O. C., 3925 and 3926) respectively 83, 145, and 178 mm. long, taken by the "Atlantis" in March, 1937, in the Gulf of Mexico, were "probably young of the preceding year," as judged by the lengths of the smaller individuals in this and other collections. Two scales of the specimen here discussed are shown in Plate I, C and D, and the arrows point to what appear to be a faint but definite annulus on each scale, indicating that this fish was in all probability a

yearling. On the basis of this observation it seems likely that the two largest of Nichols' three fish were at least two years old, and this is indeed borne out by an examination of their scales, which show what are apparently two annuli, while scales from the 83 mm. specimen have but one annulus-like mark near the periphery. It can thus be surmised that if the individuals in question are normal representatives of the population, juveniles of this species range up to approximately 75–80 mm. in length, and yearlings average 140–175 mm. at the time they become two-year-olds. Obviously, however, the foregoing cannot be considered more than conjecture until many specimens have been subjected to careful length-frequency and scale analysis. As is evident from Plate I, C and D, the scales from this particular specimen of *T. lathami* varied considerably in size (roughly up to 2 mm. in diameter) and appearance. The general pattern, however, was characteristically cycloid, although the V-shaped field in some was vaguely suggestive of the ctenoid type.

The precise position and relationships of the Carangidae have long been matters in which there has not been perfect agreement among systematists (Gregory, 1933). Regan (1909 a and b) placed the carangoids in the suborder Percoidei of the Percomorphi, and referred the scombroids to a separate suborder, the Scombroidei. This is at variance with many other authors who are inclined to the belief that there is a closer relationship between the Carangidae and Scombridae. Among those who hold this latter view are Starks, who based his opinion on detailed osteological studies (1909, 1910, 1911), and Jordan and Evermann (1896) and Boulenger (1922), who placed these two families in the same group in the Percomorph order—a group to which they gave the names Scombroidei and Scombriformes respectively. Gregory (1933), on the basis of skull comparisons as well as vertebral, rib, and fin characters, also favors the latter belief.

The skeleton of this specimen of *Trachurus lathami* was stained by a slight modification of the method of Cumley, Crow, and Griffen (1939), which makes possible the study of the osteology of small specimens in fullest detail, as shown in Plate I, A and B. In general, the characters of this individual agreed well with those of Starks (1911) in his study of the genera of the family Carangidae, in which he stated that, by comparison with the Scombridae, "The gaps between the genera are much smaller, and though the osteological characters, like the form of the body, differ much in the extremes of variation, there are no sudden or complete changes."

Boulenger (1922), in his definition of the Carangidae, listed as one of the characters a relatively small number of vertebrae, 24–26, a fact which indicates that this group is among the more primitive acanthopterygians which typically have a vertebral count of 10 + 14. This specimen of *T. lathami* fitted this picture perfectly with its 10 abdominal and 14 caudal vertebrae. It will also be noted (Plate I, A) that the rather elongate shape of this form has been accomplished by the lengthening of the individual vertebrae rather than by an increase in number, much as pointed out by Gregory (1933) for the members of the genus *Seriola*, although in general Gregory believes that the long-bodied types are derived from the more primitive laterally compressed forms which are dorsoventrally deeper. This

T. lathami also agreed with Boulenger's definition of the Carangidae in the fact that the ribs were attached behind the parapophyses, or, in the last few abdominal vertebrae, on the posterior surfaces of the parapophyses. The epipleurals, which were removed in dissection and hence do not show in Plate I, A, appeared to be on the parapophyses in this form in accordance with Boulenger (*loc. cit.*).

The structure of the caudal fin in the present specimen closely resembled that of the Bermuda Carangidae as described by Hollister (1941). The fin ray count was 18 dorsal (6 raylets plus 12 rays) and 15 ventral (4 raylets plus 11 rays), which is only slightly at variance with the arrangement in *Trachinotus palometa* shown by Hollister. There were two epurals, which agrees with most of the Bermuda Carangidae. There were four hypurals, as in all the adults investigated by Hollister, two above and two below the median line, the central bones being large and fan-shaped, and the most dorsal hypural apparently being fused with the single pair of uroneurals. In this specimen of *T. lathami* there was no remaining trace of the fact that the large dorsal hypural is formed by the fusion of two separate bones in the Carangidae as discovered by Hollister in her study of the young stages. One elongate neural and two similar haemal spines entered into the anterior part of the caudal complex, and there was a reduced neural process on the penultimate centrum, just dorsal to which was the prominent anterior extension of the first epural. The general appearance of the whole caudal fin skeleton was strikingly similar to that of *Scomber scombrus* as pictured by Whitehouse (1910: Fig. 22), whose terminology, however, differs from that used by Hollister (1936 and 1941) and followed by the present author in this work.

The skull of the specimen under discussion is shown in Plate I, B. It will be immediately apparent that it possessed the prominent extension of the sagittal crest involving the supraoccipital and frontal bones which is characteristic of the Carangidae. This crest was not short, high, and steep as in the laterally compressed fishes which Gregory (1933) considers the more primitive representatives, but instead was elongate, relatively low, and of gentle slope as in the long-bodied forms which Gregory assumes to be derivatives of the short, deep individuals. Gregory states that it "... also appears highly probable that in the primitive carangid the mouth was small, ... and that the quadrate-articular joint was moderately far forward, perhaps beneath the middle of the orbit; that subsequently larger mouths were acquired

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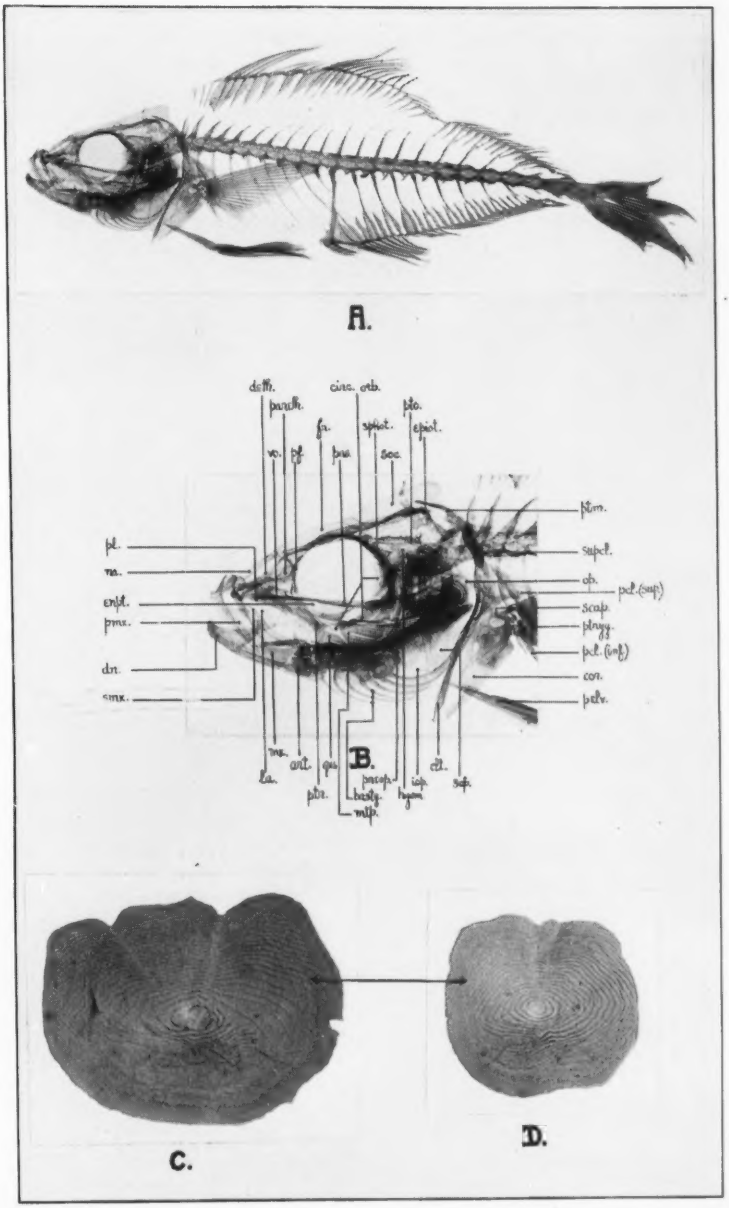
PLATE I

A. Lateral view of the skeleton of *Trachurus lathami* Nichols.

B. The skull: art., articular; brstg., branchiostegals; circ. orb., circumorbitals; clt., cleithrum; cor., coracoid; deth., dermethmoid; dn., dentary; enpt., entopterygoid; epiot., epiotic; fr., frontal; hyom., hyomandibular iop., interopercular; la., lacrymal; mtp., metapterygoid; mx., maxilla; na., nasal; op., opercular; pareth., parethmoid; pas., parasphenoid; pcl. (inf.), postcleithrum (inferior); pcl. (sup.), postcleithrum (superior); pelv., pelvis; pf., prefrontal; pl., palatine; pmx., premaxilla; preop., preopercular; ptm., posttemporal; pto., pterotic; ptr., pterygoid; ptryg., pterygials; qu., quadrate; scap., scapula; smx., supramaxilla; soc., supraoccipital; sop., subopercular; sphot., sphenotic; supcl., supracleithrum; vo., vomer.

C. and D. Two scales from a single specimen of *T. lathami.*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along with longer, swifter bodies, and more predaceous habits, either by a moderate backward shifting of the quadrate-articular joint, . . . or by a forward growth of both snout and jaws . . . ." It is interesting to note that in the present specimen of *T. lathami* the quadrate-articular joint lay under the anterior quarter of the orbit, a fact which is not in keeping with the statement of Gregory.

On the basis of the skeletal features discussed above, it is difficult to establish the precise position of *Trachurus lathami* in regard to other members of the Carangidae. The vertebral count and anterior position of the quadrate-articular joint are primitive characters that are not easy to reconcile with the body form and shape of the sagittal crest which indicate, according to Gregory's concept, specialization. It seems possible that there is an alternate explanation or modification of the idea expressed by Gregory concerning the phylogeny of the Carangidae—namely that the primitive Carangidae were intermediate between the shorter, deep-bodied, laterally-compressed individuals and the longer, round-bodied forms, and that two main lines have evolved from this stock. One of these lines has become specialized by increasing the depth of the body and acquiring concomitant features such as the change in shape and height of the sagittal crest and the forward shifting of the position of the quadrate-articular joint, while maintaining the primitive vertebral count in keeping with the relative shortness of the body. Genera of the type like *Caranx, Alectis, Vomer, Selene,* etc. are derivatives of this line. The other line has become specialized by increasing the length of the body, maintaining or intensifying the general fusiform shape, increasing the length or number of the individual vertebrae or both, possibly decreasing the slope and height of the sagittal crest, and frequently shifting posteriorly the position of the quadrate-articular joint. This would give rise to genera such as *Naucrates, Seriola, Decapterus,* etc. Such an explanation would not be at variance with the statement of Starks (1911) cited above, for starting at the end of one specialized line, continuing back through the intermediate primitive types, and following up the other specialized line would show "no sudden or complete changes," and the gaps between the genera would be small, although the extremes of variation between the ends of the two lines would differ considerably. If such an hypothesis be granted, *Trachurus lathami* might be placed fairly near the generalized basal type because of its primitive vertebral count and relatively anterior position of the quadrate-articular joint, but would be on the line leading to the specialized, elongate, round-bodied forms because of the lengthening of the individual vertebrae.

The condition of the fins may also provide evidence as to the phylogeny of the Carangidae. Thus Gregory (*loc. cit.*) points out that *Trachinotus falcatus* and *T. culveri,* which are deep-bodied and laterally compressed individuals, "have the obviously least specialized condition of the dorsal and anal fins, while in the related but longer-bodied genus *Oligoplites* (*Scomberoides*) the spinous dorsal and anal are either reduced or separated from the soft-rayed parts of the fin." This could be interpreted as evidence that the fusiform types are derived from the deep-bodied forms. On the other hand, examination of the plates of different Carangidae in Meek and Hilde-

brand (1925) show that while some of the deep-bodied types have generalized fins, those of others are highly specialized, and similarly, not all the long-bodied individuals exhibit a high degree of fin specialization. Moreover, it is also apparent that the paired and median fins in the same species may show quite dissimilar degrees of modification. Thus the pectorals may be ovate to orbicular and the dorsal and anal may be highly specialized, or the median fins may be of a generalized sort and the pectorals falcate. It would appear from this evidence that fin specialization does not necessarily go hand in hand with other types of specialization. If it be assumed that the long-bodied individuals arose from the deep, laterally-compressed ones, the fin situation presents obvious difficulties. If, on the other hand, the plausibility of the hypothesis that two lines (one leading to the deep-bodied forms and the other to the elongate types) are derived from a generalized intermediate stock be granted, the variation of fin types in individuals on either branch is quite understandable.

Finally, it should be stated that the evidence from this specimen of *Trachurus lathami* as well as that from other Carangidae leads this author to hold the same belief as Boulenger, Starks, and Gregory—namely, that the carangids are closely related to the scombrids, and that both spring from a single branch of the percoid stock which is referred to as the Scombroidei or Scombriformes. This is by contrast to the view of Regan (1909a) who states that "... the Carangidae ... show no special affinity to the Scombridae and may be placed with the Percoids." Rather, it seems highly probable that the situation is much as depicted by Dr. W. K. Gregory in his phylogenetic tree of the teleosts as used at the American Museum of Natural History in the Hall of Fishes (see Breder, 1943: Fig. 16). This shows the Scombroidei as one of the branches from the percoid stem—a branch which gives rise to a number of families, among which are the closely related Carangidae and Scombridae.

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BINGHAM OCEANOGRAPHIC AND OSBORN ZOOLOGICAL LABORATORIES, YALE UNIVERSITY, NEW HAVEN, CONNECTICUT.

The Lutianid Fishes of Texas

By J. L. Baughman [1]

ALONG the coast of the Gulf of Mexico, from Temple Bay in Florida to Brownsville in southern Texas, the sea bottom declines gradually to the hundred-fathom curve, forming vast, almost level, plains of sand. At depths of from 7 to 45 fathoms these plains are traversed by gullies of variable size, in which the water is often several fathoms deeper than the surrounding bottom. The majority of such depressions have rock or coral bottoms.

Interspersed with these, along the Texas coast at least, are reefs such as the Heald Bank at Galveston, the Twenty-four Ten Bank southeast of Brownsville, and various unnamed coral formations all along the coast. In the fishermen's vernacular, these reefs and gullies are known indiscriminately as the "snapper banks."

These banks support a heavy and localized fish fauna, mostly belonging to the family of serranids, the majority of which are reef dwellers. They are carnivorous, and, in general, comprise a group of large, active, and voracious fishes common throughout the warm waters of the world. It is with these fishes on the Texas coast, and some closely allied genera, that this and succeeding papers will deal, the first family considered being the lutianids. Several of the species listed have not previously been recorded from this coast, and one of them, *Lutianus jocu,* the dog snapper, is doubly interesting, because of this extension of its range and the enormous size which it attains in our waters.

Lutianus griseus (Linnaeus)

Mangrove snapper, gray snapper

First reported by Girard (1859), under the name *Neomaenis emarginatus,* from Brazos Santiago and the mouth of the Rio Grande, this snapper is nowhere especially abundant, although I have seen specimens from Galveston, Freeport, and Aransas Pass.

The gray snappers are nocturnal feeders, although they will bite during the day, and much data on their food is given by Longley (1924, 1927, 1930). Linton (1910) also gives some data on the food of the species, in addition to a list of the parasites. His list of the latter includes the following: *Hamacreadium gulella* Linton, *H. mutabile* Linton, *Helicometrima nimia* Linton, *Lechradena edentula* Linton, *Leurodera decora* Linton, *Microcotyle incisa* Linton, *Stegopa globosa* Linton, *Stephanocasmus casus* Linton, *Sterrhurus monticello* (Linton), and *Udonella socialis* Linton (on an Argulid parasite of *L. griseus*). Others are contained in papers by the same author, while various papers by Wilson (mostly in the Proceedings of the U. S. National Museum) give an exhaustive list of the copepods using this species as a host.

This is the species with which Reighard (1907) conducted extensive experiments on their ability to distinguish color. His evidence tended to show

1 Acknowledgement is due here to Dr. A. C. Chandler, of Rice Institute, for facilities for preserving a collection of these fishes; to Miss Alice Dean, for use of the Institute's library; and to various specialists, among whom may be numbered Mr. John T. Nichols, of the American Museum of Natural History, and Mr. Earl D. Reid, of the Smithsonian, for identification of specimens. Captain E. T. Dawson, of the Texas Game, Fish and Oyster Commission, also furnished much information.

such ability, combined with rapidity in forming associations. Longley, not satisfied with the results of Reighard's experiments, conducted much more extensive ones over a period of three years. These continued until no doubt remained that the gray snapper can distinguish color patterns, and that it can be taught to avoid certain ones, although the rate of learning seemed rather slow (Longley and Hildebrand, 1941).

L. griseus, while not possessing the extreme range of coloration of the groupers, still is quite variable, and possesses the ability to change its color phase almost instantly. One taken with a hook and line at Aransas Pass presented, while in the air, the distinct impression of a darkly barred fish, but by the time it had been removed from the hook, a matter of a few seconds, only the faintest adumbration of the barring remained. Another specimen, obtained at Galveston (USNM 120064), was mahogany brown in color.

Lutianus jocu (Bloch and Schneider)

Dog snapper

Usually taken during the summer off the reefs of the Texas coast, the dog snapper has not previously been recorded from this state. It is remarkable for the extreme size which it attains in these waters, far exceeding that commonly assigned to the species. Ordinarily, according to Evermann and Marsh (1900), it does not exceed 20 lbs. in weight, yet one of that size is rarely caught on our coast, the smallest of which I have any record being one of 48 lbs., while others weighed 72, 100, and 110 lbs., respectively. Of this latter specimen, Mr. John T. Nichols, Curator of Fishes in the American Museum of Natural History, says: "I knew that the dog snapper reached a large size, but the large specimen you mention is beyond anything I knew of." Young of the species have been taken as far north as Wood's Hole, Massachusetts.

Lutianus campechanus (Poey)

Red snapper

This species, listed by Reed (1941), who gives no locality, is of doubtful occurrence in our waters, although it may turn up occasionally as a stray from farther south. Jarvis (1935) gives its range as the coast of Honduras, remarking that some are occasionally caught off the eastern edge of the Campeche Bank. Ginsburg (1930) states that it is the common snapper of the Caribbean, easily distinguishable from *L. blackfordii,* of the Gulf of Mexico.

Lutianus aya (Bloch)

Red snapper

Reported by Evermann and Kendall (1892) as the common snapper of Galveston, brought in from banks not far distant, there is little likelihood that the identification is correct. *Lutianus aya* is a Brazilian species; while, as pointed out by Hildebrand and Ginsburg (1925), the common red snapper of our southern coast is *L. blackfordii,* first described by Goode and Bean (1878) from Florida specimens.

Lutianus blackfordii (Goode and Bean)

Red snapper

This, the red snapper of our coast, is found on all the banks from

Brownsville to Orange, and is distinctly a fish of the deep water, contrasting in this with *L. griseus*, whose favorite habitat is the shallower water near the shore.

Little is known of the life history of the species. Bean (1887) took a specimen 114 mm. in length in the Great South Bay of Long Island, but it is probable that this was a straggler, no concentrations of this species being known in that locality. Gunter (1935) records three young from Louisiana that were taken in a shrimp trawl. Two more were taken just outside the jetties at Aransas Pass, Texas, in 1940 (Gunter, 1941). Evidently the immature fish approach close to the shore at times, despite the fact that the adults seldom are found in such a location.

The greatest number of young known to the writer are the seven obtained by him in 1940, at the edge of a snapper bank about 15 miles south of Galveston. One, 45 mm. in length, is the smallest of which any record has been found. The others were 110, 115, 120, 130, and 140 mm., respectively. These were caught in August. A large female, caught on May 3, was full of masses of partly developed spawn.

One 22 pound fish caught early in March had, when brought on board, the remains of a smooth puffer, *Lagcocephalus laevigatus*, in its digestive tract. The puffer, which was approximately 15 inches long, had been swallowed head first, and while the anterior portion of its body had been partially digested, the caudal fin and a part of the posterior portion of its body still protruded from the snapper's mouth.

The maximum weight known for the species is 79 pounds. However, 20 pound fish are rare on this coast.

Lutianus analis (Cuvier and Valenciennes)

School master

A common fish in Florida, *L. analis* is seldom caught in Texas waters.

Lutianus synagris (Linnaeus)

Lane's snapper

One of the smallest of the snappers, this brilliant fish may be easily distinguished in life by the longitudinal gold barring of its sides. It is commonly caught in company with the red snapper. Not previously reported from the Texas coast.

Rhomboplites aurorubens (Cuvier and Valenciennes)

Occasionally caught at Freeport and Galveston. Distinctively shaped and partaking in little of the lutianid characteristics, it is called by fishermen there the "bastard snapper."

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311 PEDEN AVENUE, HOUSTON, TEXAS.

A New Philippine Apogonid, With Notes on Some Rare Species

By Albert W. C. T. Herre

THE Apogonidae form one of the most abundant assemblages of species found on East Indian coral reefs, and the Philippines are particularly rich in them. Many species are very widespread in the Indo-Pacific realm, but several of the loveliest or most interesting are as yet only known from the Philippines. The reefs of the Sulu Archipelago swarm with many species of this family. At Bongau I have taken more than a dozen strongly marked species from a single clump of soft coral not more than 2 feet across.

Several rare species, as well as one believed to be new, were obtained on my last trip.

Mionurus ***heraldi,*** new species

Native name, Langaroy - lo-ot

Dorsal VII-I-9; anal II-9; scales in the lateral line 23, plus one on the caudal base, 2 above and 7 below it; 5 predorsal scales; 2 rows of scales on the preopercle; gill rakers 2 + 12, the longest twice in the eye.

The body is compressed, with arched dorsal profile, flattened somewhat at the interorbital, the depth 3 times in the length. The large head is 2.5 times, the truncate caudal 3.3 times in the length. The eye equals the interorbital, and is contained 4.2 times in the head; the snout is 5.4 times, the maxillary twice in the head. The mouth is strongly oblique, with prominent chin, the maxillary extending to beneath the hind margin of the eye. The width of the expanded posterior end of the maxillary is 3.5 times in its own length, or 1⅔ times in the eye. The least depth of the caudal peduncle is 2⅓.

The thin, loosely attached scales are feebly ctenoid, the teeth often rubbed off and then apparently cycloid; many scales have been lost. The dorsal spines are weak, the fourth and fifth longest, 3 times in the head; the second dorsal spine is only slightly shorter, the longest rays 1.5 times in the head. The longest anal rays equal the pectoral length, and are contained 1.75 times, the long pointed ventrals 1.55 times in the head.

The preopercular margin and ridge are smooth, the orbital rim crenate-dentate on its lower and posterior parts. The very small, conical teeth are in a single row in the lower jaw. The upper jaw has a toothless notch at its tip, in which the tip of the lower jaw fits; back of this extends a short row of teeth on each side, all exposed when the mouth is closed; behind these the exposed jaw margin is covered by a hard band, like sandpaper. There is a short row of teeth on each side of the vomer, and a double row on each palatine bone.

The color in alcohol is pale brown, with a more or less evident vertical dark-brown bar under each scale; there is a blackish spot on the upper half of the spinous dorsal, and a wide dark-brown crossband on the second dorsal and the anal, which are otherwise clear; all but the basal part of the caudal is dusky; the pectorals and ventrals are clear.

Here described from the type and sole specimen, 106 mm. standard length, taken by a trawler from Ragay Gulf, Luzon, Philippine Islands.

This species is very different from *Mionurus mydrus* Jordan and Seale, and *Mionurus bombonensis* Herre, both from the Philippines.

Named for Earl Stannard Herald, able and enthusiastic student of pipefishes.

Cheilodipterus subulatus M. Weber

This rare species has been known hitherto only from a single specimen 220 mm. long. taken from the sea at Makassar, Celebes. I obtained 2 examples, 86 and 139 mm. in length, from a coral head in a lagoon on an island a few miles west of Jolo, and another 143 mm. long from the reef at Sitankai, Sulu Archipelago.

The body is robust, with very large head, large mouth and long strong canine teeth. The depth is 2.68 to 2.86, the head 2.28 to 2.38, the caudal 3.8 to almost 4 times in the length. The eye varies from 4.3 to 4.7, the snout 3.6 to 3.75 times in the head. The interorbital is 1.44 to 1.55 times in the eye. The maxillary extends beyond the eye, or may not reach beyond the hind margin.

The color in alcohol is brown with traces of 3 darker longitudinal bands; the upper goes from the snout across the upper part of the eye to the upper part of the caudal base; the second passes from the snout to the middle of the eye and on to the middle of the caudal base; the third passes from the snout under the eye and back to the lower part of the caudal base; dark crossbands over the back can be made out also, below the first and second dorsals and over the caudal peduncle.

Apogon chrysopomus Bleeker

Fowler has placed this under the synonymy of *A. fusca,* but this disposition is very doubtful, to say the least. A specimen 79 mm. long was taken from a coral reef near Jolo. This species is easily recognized by the circular golden spots on the opercle and preopercle. It is abundant on the reefs at Sitankai and throughout the Sulu Sea.

Apogon kiensis Jordan and Snyder

A specimen 74 mm. long of this Japanese species was taken by trawl from Manila Bay. This is the second time this species has been collected in the Philippines, both times in Manila Bay.

Apogon leptacanthus Bleeker

Dorsal VI-1-9. Fowler has confused this with *A. hypselonotus* Bleeker, which has 7 spines in the first dorsal, while Roxas and Martin have placed both in the synonymy of *A. melas* in their *Check List of Philippine Fishes.* They are correct for *hypselonotus,* but not for *leptacanthus.*

Three young specimens, 15-30 mm. in length, were taken from a tidal creek at Cagayan de Misamis, Mindanao.

Apogonichthys elliotti (Day)

This Indian species has been taken only by dredging or trawling in the Philippines, at depths from about 70 to 370 feet. Three examples, taken by trawling in Ragay Gulf, southeastern Luzon, are 57 to 80 mm. in length.

Apogonichthys poecilopterus (Cuvier and Valenciennes)

Nine examples, 75 to 100 mm. in length, were taken by trawling in the Gulf of Ragay, at a depth of about 125 feet. The first dorsal is black, except basally. *A. glaga* Bleeker is a synonym.

Apogonichthys striatus (Smith and Radcliffe)

Dorsal VII-I-9 or 8. Nine typical examples, 43 to 50 mm. in length, of this strongly marked species were taken by trawling in Manila Bay.

NATURAL HISTORY MUSEUM, STANFORD UNIVERSITY, CALIFORNIA.

The Early Embryology of *Platypoecilus maculatus* [1]

BY ARTHUR F. HOPPER, JR.

INTRODUCTION

THE regularity of brood production in the poeciliid fishes has led to detailed studies of their reproductive cycles. Among other interesting results has been the discovery of superfoetation—a phenomenon involving the fertilization of a second group of eggs, sometimes by sperm from the original mating, while the first group of developing embryos is still retained within the mother. Superfoetation is developed to an extreme degree in *Heterandria formosa*, in which Turner (1937) reported the birth of a group of embryos every three to eight days during the summer months, with one female killed in May carrying six separate groups of developing embryos.

However, in the majority of viviparous poeciliids a second group of eggs is not fertilized until the first brood is born. Turner (1937) has distinguished three separate types on the basis of the extent to which the second group of ova are developed at the time of the birth of the first. Thus, in the *Quintana atrizona* type there is only a short time between the birth of one brood and the fertilization of the next, while in the *Lebistes* type the next group of eggs are so undeveloped at the time of the birth of the first brood that a growth period must intervene before fertilization can occur. Finally, in the *Gambusia* type, this growth period is prolonged to about nine days. In both these latter types there is a regular reproductive cycle of about 30 days between broods in the late spring and early summer.

Viviparity in teleosts is usually associated with the development of specialized structures whereby the embryo, remaining inside the ovary, receives the greater part of its nutritive supply from the mother. Apparently viviparity is a secondary specialization of oviparity, because in the early stages

[1] The author wishes to express his indebtedness to Dr. Myron Gordon and Dr. Daniel Merriman. The former supplied the fish and was a source of constant encouragement; the latter made many helpful criticisms and suggestions and has corrected the proof.

of the development of this phenomenon the embryo carries its own supply of food while it is temporarily given protection inside of the mother. Only at a later stage in the development of viviparity, in the more specialized groups, does the embryo assume an intimate association with the maternal tissue and become dependent upon the mother for its food supply. Ova of the least specialized groups have an amount of yolk sufficient to fulfill the nutritive requirement of the embryo, while ova of the more specialized forms, in which the embryo tends to become dependent upon the mother, have only a relatively small amount of yolk. Correspondingly, in these latter groups, a series of unique and temporary structures are developed in order to provide for both food and oxygen supply. In the most specialized Poeciliidae, where the amount of yolk is small, Turner (1940 a, b, c and d) has described such singular structures as the development of a follicular pseudoplacenta (*Poeciliapsis* and *Aulophallus*) and the formation of an enveloping pericardial sac with an outer vascular layer and an inner nonvascular layer, termed respectively the pseudochorion and the pseudoamnion (*Heterandria*). However, in the more typical Poeciliidae the embryo retains a sufficient amount of yolk to carry it through development and the specializations found then are those which have to do with respiration. *Platypoecilus* is one of the so-called typical forms. The embryos are fertilized within the ovary and retained within the ovarian follicle until just before birth, when they are passed into the ovarian cavity and thence out the oviduct. Purser (1938) has shown that in *Lebistes* there is an opening in the ovarian follicle which presumably allows the entrance of the spermatozoa. Fraser and Renton (1938) state that in the egg of *Heterandria,* in which the sperm cluster, a protuberance is formed toward the ovarian cavity. In *Platypoecilus* no orifice or protuberance has been reported, nor was any found in this study and the mechanism by which the sperm enters the egg is not known.

Materials and Methods

In the present study the species *Platypoecilus maculatus* was used exclusively. The fish were early generations of forms which had been imported directly from Mexico. At present Hubbs and Gordon "in an unpublished manuscript entitled 'Fresh-water fishes of Northern Mexico,' recognize four species of *Platypoecilus*" (Gordon, 1927). They are *P. couchianus, P. xiphidium, P. variatus* and *P. maculatus.*

Platypoecilus is a hardy form and quite resistant to temperature changes, but since the maximum number of broods is obtained when the fish are kept at higher temperatures, the water in the aquaria was usually kept at about 80° F. At night artificial lighting, 60-watt bulbs in gooseneck lamps, was employed both to maintain the temperature and because it has been suggested by Turner (1937) that the small amount of daylight during the winter months in temperate regions appears to be one of the main reasons for a cessation of breeding activity of laboratory-kept forms during the fall and winter. Even with this artificial lighting, it was observed that the regularity of brood production diminished during the winter.

Mature females were isolated with one or two males in 2-gallon tanks and were killed at definite time intervals after a brood was born. Younger

fish were raised to maturity in 8-gallon tanks. All aquaria were well supplied with green plants and all fish were fed a variety of live and dried food which consisted of several kinds of prepared commercial food as well as *Encytraeus, Daphnia, Artemia,* chopped earthworms, shrimp and clams.

When the females were killed, the ovaries were immediately removed, the visceral peritoneum cut away and each of the follicles containing the embryos fixed separately. Bouin's fluid was used for the material to be sectioned and Petrunkevitch's formula (1901) for mounts. Often as much yolk as possible was cut away while the tissue was in 70% alcohol. All material was sectioned at 10 μ, stained in Delafield's hematoxylin and counterstained with eosin.

Descriptive Results

Fertilization

Platypoecilus maculatus has a 28–30 day period between the birth of each brood—subject, of course, to individual and seasonal variation. It seemed reasonable to expect that fertilization of the second group of ova occurred shortly after the birth of the first brood, and that the 30-day period then represented the length of gestation. However, the examination of females which were killed at definite time intervals after they had given birth to one group of embryos gave good evidence that fertilization does not take place for a week or more after the birth of a previous brood. Table 1 shows the results of this work.

The ovary of a female sacrificed at one and a half days after the birth of a brood contained no fertilized ova. However, the next two groups of eggs which were to be fertilized were discernible (Fig. 7). The first of these groups, the oldest eggs—those which would be fertilized to form the next group of embryos—were uniformly larger. The other ova—those which would not be fertilized until after the birth of another brood—were scattered throughout the ovary. The younger and smaller ova which made up the latter group could be distinguished from those ova which would be fertilized immediately on the basis of two criteria other than size. Firstly, the follicle surrounding the more mature egg was extremely thin and never columnar nor lobulated. Secondly, the cytoplasm of the younger cells always stained darkly. This columnar and lobulated appearance of the older eggs suggested a high degree of activity. At the same time the cytoplasm was highly vacuolated and no longer stained darkly. However, as this group of older ova matured the yolk became markedly thicker and stained as an almost solid black mass except in the region of the germinal vesicle. This is in agreement with the results published by other authors (Merriman and Schedl, 1941).

The ova in a female killed two and a half days after the birth of a brood were slightly larger than those in the preceding ovary and showed a denser accumulation of yolk. All ova at this time were approximately 1 mm. in diameter. Again a number of smaller eggs about 0.1 or 0.2 mm. in diameter were present throughout the ovary. Females sacrificed at 4, 5, and 6 days after birth of a brood contained eggs which were all about 1 to 1.3 mm. in diameter with darkly staining yolk. The ova did not increase in size after this. In all cases the epithelium was thick and lobulated.

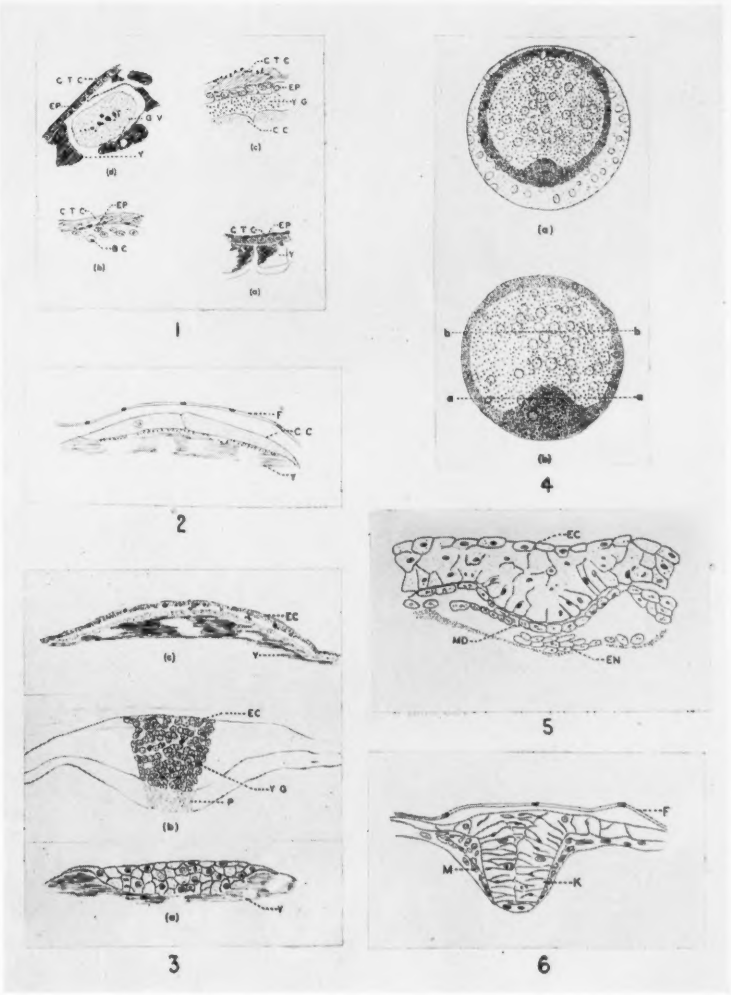

PLATE I

1a. Follicle before fertilization. 1b. Follicle at blastula stage. 1c. Follicle in two-cell stage. 1d. Germinal vesicle just before fertilization. 2. Two-cell stage. 3a. Section through early blastula. 3b. Section through early germ ring. 3c. Section through early germ ring outside of embryonic area. 4a. Drawing of a whole mount of an early germ ring stage. 4b. Drawing of a whole mount of a later germ ring stage. 5. Section through plane a-a of Fig. 4b. 6. Section through early medullary plate.

BC, blastodisc cell; C C, cleavage cell; C T C, connective tissue capsule; EC, ectoderm; EN, entoderm; EP, epithelium; F, follicle; G V, germinal vesicle; K, keel; M, mesenchyme; MD, mesoderm; P, periblast; Y, yolk; Y G, yolk granule.

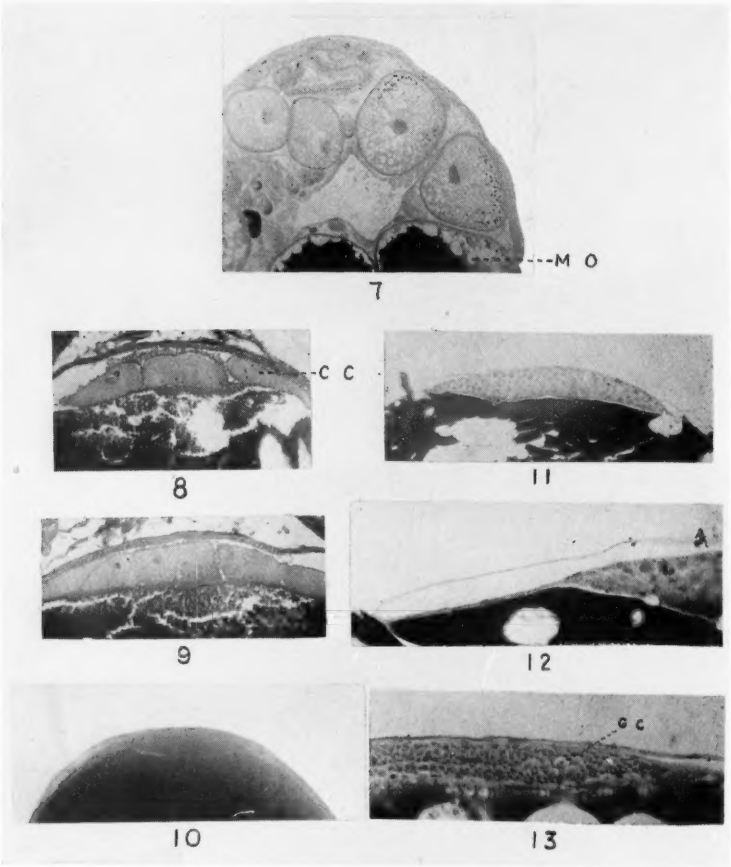

PLATE II

7. Whole ovary from a female killed four days after giving birth to one brood. 8. Eight-cell stage. 9. 36–50 cell stage. 10. Whole mount of an early blastula. 11. Cross section of early blastula. 12. Cross section of edge of blastula. 13. Germ cells in mid-gastrula stage.

C C, cleavage cell; G C, germ cell; M O, mature ovum.

The first fertilized ova were found in a female killed 7 days after the birth of a previous brood. Only about 4 or 5 of the large ova, of which there were approximately 15 to 20, were fertilized and these were in early cleavage stages. Females killed 8, 9, 10 and 11 days after birth of a brood contained stages ranging from blastulae to Oppenheimer stage 25 (formation of urinary vesicle). Therefore it appears that fertilization in *Platypoecilus maculatus* may take place over a period of time ranging from the sixth to the eighth day after the birth of a previous brood. Sperm were almost always present in the female genital tract. Van Oordt (1938) states that, in *Xiphophorus*, sperm from a single copulation may live in the female genital tract and bring about fertilization of a group of ova each month for a period of at least ten months, and it would thus appear that fertilization in such instances depends upon the attainment of a proper degree of maturation of the ova.

TABLE I

Record of examination of ovaries in females killed 1 to 11 days after the birth of a previous brood. Non-parenthetical numbers refer to number of females examined. Figures in parentheses refer to identifying number of the fish.

Days	Unfertil-ized	Early Cleavage	Late Cleavage	Blastula	Gastrula	Later Stages
1½	1(23)					
2	1(17)					
2½	1(3)					
3½	1(5)					
4	1(7)					
5	1(9) 1(10)					
6	1(32)					
7	1(15)	1(18)				
8		1(4)				
9			1(23)	1(25)	1(20)	
10					1(24)	
11						1(22) 1(26)

The final maturation processes take place over a period of 7 or 8 days after the birth of one brood, and fertilization occurs only when these processes are sufficiently advanced. This is further supported by the fact that examination revealed that all embryos in any one ovary were not in the same stage of development. Stages ranging from blastulae to stage 20 (optic lobe formation) were all found in a single ovary, representing a developmental difference of at least a day between the two extremes. This phenomenon was found in all ovaries examined and as it is not probable that differences in developmental rates in different embryos could account for the discrepancies, it is evident that all ova are not fertilized at the same time.

DEVELOPMENT

The mature egg of *Platypoecilus maculatus* was about 1.3 mm. in diameter. Due to the fact that large numbers of eggs were packed close together in the ovary, they frequently assumed irregular shapes. However, when the living egg was removed from the ovary it immediately became

round. Due to the presence of a large amount of yolk the eggs were opaque. A thin layer of protoplasm and numerous oil granules covered the surface of the egg. Before fertilization the nucleus was central in position but at about the sixth day after the birth of a previous brood the germinal vesicles in the mature ova moved peripherally until they occupied the position shown in Figure 1d, when fertilization took place. Owing to the difficulty of determining accurately the precise time at which it occurred, the actual process of fertilization was never observed. Furthermore, the cleavage cells in the living egg were extremely indistinct and it was practically impossible to observe cleavage in the living material. In fact, a number of eggs which were thought to be unfertilized when first observed immediately after the mother was killed, were, after fixing and staining, found to be in cleavage stages. Blastulae and gastrulae were equally indistinct in the living material and for this reason all stages up to the formation of the embryo were best studied from sectioned material. A drawing of the first cleavage stage studied, two cells, is seen in Figure 2. Note that the first cleavage plane cuts completely through the blastodisc. A later cleavage stage is seen in Figure 8. This represents an eight-cell stage, and in all probability cleavage in *Platypoecilus* follows much the same sequence as Oppenheimer (1937) has described for *Fundulus*. The follicular cavity, apparent in this figure, persisted until birth. The cleaving cells were sharply demarked from the underlying yolk, but were surrounded by yolk granules which were even found lying above the cells and in the follicular cavity. Figure 9 shows a later cleavage stage of about 36–40 cells. The yolk immediately below the cells was at this time much more granular and the sharp boundary between cells and yolk was disappearing. As cleavage proceeded, the blastoderm took on the form of a small round mass of cells slightly raised above the surface of the yolk. The appearance of the apical pole of the whole egg at this time is seen in Figure 10, which represents a whole mount of an early blastula. Figure 3a shows a cross section through such an early blastula. The cells were still large and irregularly shaped, while those which lay next to the yolk were relatively smaller with indefinite cell boundaries. The cells on the edge of the blastodisc became attenuated and stretched over the yolk for some distance. Many mitotic figures were now apparent. After this stage cleavage continued rapidly and the blastodisc began to spread over the yolk. Figure 11 shows an early stage in this process. The individual cells were noticeably smaller than in the preceding stage, while the whole blastoderm covered an area approximately twice as large. The cells were not as closely packed as they were in the early blastulae and many clear spaces appeared between them. Yolk granules were also included in the blastodisc among the cells. The beginning of the formation of an ectodermal covering was represented by the outer flattened layer of cells. Even in the early stages some of the blastoderm material moved out to begin to encircle the yolk (Figure 12). Thus, a layer of protoplasm extended about half way around the yolk, even before gastrulation. As the blastoderm moved over the yolk there was a noticeable thickening at one location along the germ ring after it had spread about half of the way over the apical pole; this marked the beginning of the embryonic axis. Figure 4a represents a top view of the apical pole, drawn from a whole

mount of an early germ ring stage. A cross section of such an embryo through the thickened part of the germ ring is shown in Figure 3b. The thicker medial portion gradually tapers off into the thin extra-embryonic region on each side. An ectodermal covering was present and the central periblast was well marked off. A cross section of the same embryo through a plane which does not include the embryonic area is seen in Figure 3c. The cellular area was only about one quarter as thick as in Figure 3b, while there was a large cavity underlying the thin ectodermal covering containing only a few scattered cells. Thus, except in the region of the embryonic material, the cellular covering of the yolk was very thin and in the living egg was extremely difficult to see. The germ ring now continued its advance and Figure 4b is a view of the apical pole drawn from a whole mount of a still later stage, when the germ ring covered almost half the yolk. Figure 5 is a cross section of such an embryo taken through the plane a-a of Figure 4b. It is obvious from Figure 5 that cellular differentiation has progressed rapidly. The medial band of cells represents the beginning of the formation of the medullary plate. An endodermal layer is seen below this plate and scattered between the two are the mesodermal cells. Figure 12 is a longitudinal section through a mid-gastrula. The primary germ layers were well formed and periblast cells were clearly visible. Near the dorsal lip, at the posterior end of the embryonic axis, a group of cells stood out because of their different size and distinctive staining characteristics. These larger and more lightly staining cells, which could be readily distinguished from the surrounding soma cells, were the primordial germ cells. This was the earliest stage at which germ cells have been found in this form. Wolff (1931), in studying the origin of germ cells in *Platypoecilus maculatus*, traced them back into a 1.6 mm. embryo in which the neural tube, notochord and myotomes had already been formed. In the present investigation the germ cells have been found to be clearly differentiated at a mid-gastrula stage.

After the germ ring had covered approximately half the yolk, it appeared to continue over the remainder of the distance at a relatively slower rate and did not completely close until about stage 20 (formation of the optic lobes). However, even before the closure of the blastopore, differentiation in the embryonic axis proceeded rapidly. Figure 6 represents a cross section of a stage slightly later than that represented in Figure 5. The embryonic Y-shaped keel was well developed, marking a later step in the differentiation of the medullary plate. Mesodermal cells were present lateral to this keel. Both these stages outlined above and the following ones concerned with the early formation of the embryo, proceeded with extreme rapidity. It is probable that the embryo becomes well differentiated in about three or four days after fertilization. It would appear then that the major part of the gestation period is concerned mainly with further growth.

Summary

Platypoecilus maculatus has a regular 28–30 day breeding cycle, as do the majority of viviparous cyprinodonts. However, after the birth of a brood, approximately the first 7 days of the next cycle are taken up by maturation processes of the group of ova which are next to be fertilized.

Fertilization was found to take place from the sixth to the eighth day after the birth of a previous brood. Apparently, all of the ova do not mature at the same time and therefore they are not fertilized simultaneously. Consequently, although the embryos in one ovary are all born over a period of a few hours, those embryos in any one ovary are not all in the same developmental stage.

The early stages up to the formation of the embryo are extremely difficult to see in the living egg. However, fixed material indicates that these early stages, as well as the later ones, are essentially similar to those described by Oppenheimer (1937) for *Fundulus*. Primordial germ cells were first noted in the mid-gastrula stage. Differentiation proceeds rapidly, so that the embryo is almost completely formed 4 or 5 days after fertilization, and the remainder of the gestation period is concerned with further growth of the organs already laid down.

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Osborn Zoological Laboratory, Yale University, New Haven, Connecticut.

Observations on the Life History of the Brazilian Frog *Oocormus microps*

By Bertha Lutz

DURING the second half of July and the following months of 1942, I had the opportunity to observe the development of a clutch of eggs of the leptodactylid frog *Oocormus microps* Boulenger. The eggs were found on July 18 in the forest on the Tijuca Mountains, in the State of Rio de Janeiro, at rather high altitude. As this was the last day on which private cars were allowed out, owing to the shortage of petrol, I had decided to make one more attempt to find the eggs of the two larger species of *Eleutherodactylus* that occur in this region. I had once found those of the small kind. I was accompanied by Joaquim Venancio, the laboratory helper of Professor Lutz for twenty years.

Diligent search was rewarded by finding a clutch of eggs of a type unknown to us, in a steep bank several feet high and a few yards away from water-logged ground where a formation of the reed *Calathea cylindrica* (associated with heliconias in the drier spots) obstructs the bed of a very small brook. The eggs were laid in a small natural hollow, covered only by a few dead leaves. There were no signs of preparation of the cavity by the adults, nor was there any foam or collective involucre. The mass was irregular, about 25 to 30 mm. at the surface and composed of some thirty eggs in one or two layers. The large eggs, 6 mm. in diameter, had thick translucent jelly. Each contained an embryo, evidently some days old, resting on a very large cream colored yolk. The very flat embryos had conspicuous black eyes, the heart pulsating in the cephalothoracic fold, and a free tail curving round the inside of the egg coat and ending in a blunt tip in front of the face. The middorsal region exhibited a little light gray pigment. Reddish areas over the yolk surface indicated blood vessels striking out from the sides of the body and curving round the yolk, with others along the tail. As the embryos became restive on exposure to light, we kept them covered.

We managed to lift out the nest entire, with a thick slab of earth, and to transport it to the Museum. It was placed in a terrarium in conditions as similar to the original ones as possible. Moisture, darkness and protection from predatory insects were provided. The last is very necessary, since a number of insects eat frog's eggs, or use them as a food for their offspring.

The eggs were observed from the day of discovery to hatching and until well beyond metamorphosis. Daily protocols were kept. As I had only one clutch of about thirty eggs, specimens were preserved only when important developments were noticed. The others were examined alive, in water, in damp Petri dishes inverted under the microscope, and by Prof. Lutz' method of examination inside small tubes, immersed in the liquid they contain or another of similar refractive properties, which enables examination from every side.

Considering the circumstances in which the clutch of eggs was found, their large yolk, and their relatively small number, we expected direct development. At first we hoped that they might be those of an *Eleutherodactylus*, but this hope waned when, on the third day, an egg hatched while separated from the

rest for examination and photography, and especially when later in the day several larvae put their tails through the egg coat. Next morning 29 tadpoles had hatched and one remained stuck in the egg. The process, evidently slow, was not entirely witnessed. Most of the larvae emerged tail first. This proved to be the beginning of an interesting and somewhat aberrant life history, characterized by non-aquatic tadpoles with a very short period of larval life, extremely abundant yolk and a few abnormalities of structure. The tadpoles never sought water, though it was within easy reach. They remained in their original nursery until six days after metamorphosis. If put into water and kept there over an hour they did not die but neither did they swim, remaining quiet, even under a stimulus that would have set much less mature hylid tadpoles into darting motion.

Fig. 1. Tadpole mass of *Oocormus microps* in earth nest, at time of metamorphosis.

When it became evident that the tadpoles were non-aquatic, we carefully considered all the frogs of this region whose spawn they might be. Excluding those whose life histories we know and those that seemed unlikely, we concluded that this must be *Oocormus microps*, the small leptodactylid resembling *Ceratophrys*, but without a prolonged upper eyelid.

I have long used the form of the eye and the color of the iris as a routine method of differentiating living species of frogs, which usually gives excellent results, especially in tadpoles nearing metamorphosis. Prof. Lutz first called my attention to such differences as an easy way to differentiate his two green hylas, *Hyla albofrenata* and *Hyla albosignata*. In this case it was particularly useful, as the eye of *Oocormus microps* is very characteristic. It has a meniscus, very similar to that of *Cyclorhamphus*, in the middle of the upper inner rim of the iris, and a corresponding notch in the middle lower part. The inner zone of the iris is gold green (Pale Viridine Yellow, Ridgway, 1912, with metallic lustre) and separated from the duller outer zone by a dendritic black line. A chestnut colored equatorial band, composed of two horizontal triangles, truncated by the pupil, completes the pattern. These characters began to appear on the eighth day after hatching.

The embryos remained in the egg four days after being found. The larval period lasted 17 days. The tadpoles hatched in what Boulenger calls the third

phase, with rudimentary hind limbs. The general appearance was that of the usual tadpole, but with some peculiarities. The yolk was so abundant that it outlasted the tadpole stage; a specimen killed on the 17th day after metamorphosis still had yolk in the intestine. The mouth apparatus was that of the normal tadpole, but with the labial teeth considerably reduced. The anus, on the other hand, was large and bilobed in a very peculiar fashion not hitherto observed. No spiraculum was found at any period of the development. The tail was relatively short, straight, blunt and shallow: the muscular part was relatively deep and the crests very narrow.

The larval habits agree with these characters. The abundant yolk provides the tadpoles with sufficient reserves to enable them to lie quietly in the nest and grow. The mouth does not seem to be used for eating but helps in moving. A spiraculum is hardly necessary to non-aquatic tadpoles. Large yolked eggs are regarded as correlated with shortening of the larval period. I venture to suggest that large yolk may also afford protection from the hazards of free life in an aquatic medium. I have noticed several times that the presence of abundant aquatic insects with hard jaws in our waters coincides with a dearth of well grown tadpoles even of common species of *Hyla* with egg complements varying from hundreds to over a thousand.

At the time of hatching the tadpoles are much rounded, owing to the curvature of the cephalothoracic region in the egg and to the yolk, which swells up the abdomen. As development proceeds the body straightens out, flattens somewhat and becomes more pear shaped. At metamorphosis the outline is rather square. After that the body grows increasingly egg shaped. The tail is never more than double the body length.

Growth is most perceptible in the cephalothoracic region, the anus and especially the hind limbs. The body is 4.5 mm. long at hatching and about 7 mm. at metamorphosis; the tail increases from 9 or 10 mm. to 11, or 12 at most. Adults reach 34 mm. and exceptionally 36 mm.

The skeleton seems to begin to form within the egg. Incipient occipital arches of cartilage or bone became perceptible in the embryos a day before hatching. They were seen to grow forwards, and especially backwards during the first nine days; after that the pigmentation concealed them. They had then reached the middle of the body along the middorsal line, as a narrow canal with two short prongs in front.

The rudimentary hind limbs grew from little cones, 1 mm. long, to the perfect 6 mm. legs in the 17 days of the larval period. The lobes of the future toes were noticed on the 6th day after hatching, and the toes seemed fully formed by the 8th. The tibio-tarsal joint was well marked on that day. On the 11th day all the joints were formed and functional.

The hands were first seen in the brachial cavity on the 8th day, but the skin began to bulge over the region of the elbows in immersed tadpoles on the 4th day. On the 11th day the shape of the hand was clear, with its short fingers; the third the longest. On the 17th day several of the larvae thrust out the left arm and next day all had put out both arms. I have seen the left arm emerge before the right a number of times in frogs, as the spiraculum seems to furnish an easy way out. When it was more ventral, the hand passes out first, not the elbow, as in larvae with a lateral spiraculum. This might lead one to believe that *Oocormus* must have at least a vestigial spiraculum, but I was unable to find it.

When the embryos were found the black eyes were the most conspicuous feature. Those fixed during or soon after hatching show the iris and pupil to be neatly differentiated. The green gold color of the inner rim of the iris became noticeable on the 8th day; the meniscus was first seen on the 13th; the corresponding notch three days later, one day before metamorphosis. The chestnut band appeared after metamorphosis. The meniscus is evidently mobile and can be turned up. In certain positions it gives the impression of a prolongation of the upper lid. The meniscus should enable the half buried frog to look through the notch in the lower rim, even with much contracted pupils. Both embryos and tadpoles are very sensitive to light. The embryos plunge and rotate away from it. Even full grown tadpoles become very restive when exposed to strong illumination. The quite young metamorphosed specimens can climb a little but prefer to hide under leaves and twigs. Within a very few weeks they learn to dig themselves in like the adults.

The tympanum was not visible in my metamorphosed specimens. Nor is it to be seen in either adults or partly grown specimens in the Adolpho Lutz Collection. This point is important as some authors regard *Oocormus microps* as the same as *Zachaenus parvulus* (Girard). *Zachaenus parvulus* according to both Girard and Cope has a very conspicuous tympanum.

The mouth apparatus looks quite normal at first sight. The oral disk is ventro-terminal, fleshy and wide. The upper lip is long, reaching below the opening of the beak. It forms two large lateral lobes that can be turned down. The lower lip is much shorter and has continuous papillae. Two or three large papillae connect the lips. The labial teeth are in $\frac{1\text{-}1}{1}$ rows; the upper row, barely perceptible at hatching, subsequently becomes strong, continuous, and dark between the 4th and the 11th day. It is broadly interrupted in the middle; the teeth are inserted only on the lateral lobes of the lip and thin out slightly toward the outer edge. The lower row is never well developed; its teeth remain small, weak and irregular with large intervals between them.

The projecting anal lobe grows from 0.5 mm. to over 1 mm. The bilobation is hardly noticeable at first but becomes extremely marked as growth proceeds. At metamorphosis the anus is compressed by the sturdy legs, and looks almost like a pair of mammalian testicles. It dwindles after that but the edge is raised even in adults.

The heart forms early. The network of blood vessels over the yolk sac is visible during the first eight days at least. During the first eleven days there were always a few tadpoles lying on their backs, which may help the exchange of gases in the blood system. Bubbles of air were seen issuing from the mouth of a tadpole put into water on the 4th day. Functional nostrils were in evidence on the 8th day. Very small paired organs were seen, one to each side of the heart, on that day; they developed slowly and seemed rather late in appearance for lungs, but I do not see what else they could have been in their position.

The tadpoles did not move on the first day while under observation. On the second they lifted and stretched the forepart of the body. After the 4th day they began to glide about, apparently using the oral disk and anal region as fulcra. After the legs became long, but while still held out stiff, they pushed each other with them. When the articulations developed they made awkward leg movements. As soon as the arms were out the little *Oocormus* sat up very

primly in their nest, but they remained in their nursery for six days after metamorphosis.

The diffuse pigmentation of the embryos increased after hatching, and by the 5th day the tadpoles looked much darker. On the 9th a dark frenal line had developed. By the 13th day they were no longer gray but olive. At the time of metamorphosis alternate light and dark patches on the head were forming. The characteristic, roughly hourglass shaped dorsal spot appeared three days later and in two more a thin fold began to form round it; a few scattered pustules developed simultaneously.

As metamorphosis approached the tail became diaphanous. When the arms emerged and the tadpole mouth was shed it was still quite long, but it showed the accumulation of pigment near the middle as was first mentioned by Budgett in connection with *Phyllomedusa hypochondrialis*. I have seen it in several tadpoles and believe it to be a phenomenon connected with histolysis.

Fig. 2. *Oocormus microps* Boulenger. Left to right: dorsal view of juvenile specimen; dorsal view of specimen 18 days after metamorphosis; and ventral view of adult, to show characteristic coloration.

By the end of August our 13-day old *Oocormus* showed three different types of dorsal ground color. Some were pea green, others more olive, and still others dark brown like the earth in the terrarium. The dorsal ground color of the adults varies even more. We have found adults of this species in the same place, calling in the same way, at various times of the year, even in our very mild winter, sometimes quite close to each other. The species exhibits four different colorations: green, rosy, yellowish, and dark (Ridgway, 1912: Olivine to Malachite Green; different tones of Vinaceous; Cinnamon Buff; and Fuscous to Benzo Brown). The ventral coloring of the adults is much more constant. They are fuscous black on the throat, posterior aspect of the thighs, knees, and heels, and fuscous with light flecks on the rest of the underside, including the limbs. This pigmentation develops slowly. Nine days after metamorphosis our little frogs showed a little pigment on the throat; on the 18th day some on the knee and still later on the abdomen.

There are some difficulties as to the name of this species. My specimens agree with Boulenger's description of *Oocormus microps*. A photograph sent to London by Prof. Lutz and kindly compared with the type by Dr. Parker

confirms this. Some authors, however, regard Boulenger's species as synonymous with *Zachaenus parvulus* (Girard), the type species of *Zachaenus*. The descriptions disagree on several points, especially as to the tympanum, the tongue, eye, and metatarsal tubercles. Girard's Latin diagnosis states "tympano conspicuo." He adds in the description that the eyes are of medium size; the tongue rather small and subcircular and attached by its whole surface, and that there are two small metatarsal tubercles. Boulenger says: "Tympanum hidden under the skin . . . Tongue large covering the whole floor of the mouth . . . eye very small . . . a large oval inner and a smaller, rounded outer metatarsal tubercle." Girard's figure 34 (the whole animal) is reproduced by Nieden, and some very nice outline drawings of his other figures were sent to Prof. Lutz, by Mrs. Helen T. Gaige. The figures of hand and foot (37 and 38) agree well with our specimens, but there is no metatarsal tubercle; 34 and 35 (profile of the head) show a very conspicuous tympanum, not to be seen on any of our specimens. Miranda Ribeiro suggests that the tympanum might be visible in the young specimens, evidently because he had only one very large specimen (he believed the species to be rare), and because Girard's type is only 21 mm. long. Fig. 34 looks much more like a *Crossodactylus* than like our species and shows a very long 4th toe. The profile of the head suggests a *Leptodactylus*. It seems unlikely that Cope should put something totally different from the *Ceratophrys* into this group, yet there is no denying the differences. I should very much like to know if Girard had only one specimen, whether it is available for comparison and whether Cope saw it. For our species it seems preferable to use the name *Oocormus microps* Boulenger, since his description agrees best with the characters of the species whose larval habits I have been privileged to witness.

When one compares the generic characters of some related genera of Brazilian frogs, like *Zachaenus, Borborocoetes, Oocormus, Cyclorhamphus, Craspedoglossus* and even *Odontophrynus,* one cannot fail to be impressed by the lack of sharp distinctions. A closer study of anatomy and of life histories will shed light on relationships and affinities and on differences not made clear by stereotyped morphological descriptions, for which purpose a revisionary study should be made. For the time being, I am content to point out a few points of similarity noticed in certain frogs of this region. The iris of both *Oocormus* and *Cyclorhamphus* has a meniscus. The tadpoles of *Oocormus* and those of *C. juliginosus* and *C. pinderi,* reared by Lutz, do not seek water. *Cyclorhamphus* larvae have a longer tail, less yolk and a vestigial spiracle. They can swim but keep the fore end of the body out of the water and generally just glide over wet rocks in the mountain streams in which the adults live. In this they resemble the tadpoles of *Thoropa*. The older tadpoles of these two types are easily distinguished by the webbing of the feet. The adults live in close proximity to each other as recently seen by myself in Theresopolis. Noble places *Thoropa miliaris* in *Borborocoetes,* following Boulenger's lead. Into this same genus others put *Craspedoglossus bolitoglossus,* in which the tongue is distinctive, and which also has the inguinal gland of *Cyclorhamphus,* as pointed out by Lutz. Our specimens do not permit one to look for the meniscus but are very *Ceratophrys*-like in species of *Cyclorhamphus,* which, especially those with unwebbed feet, do not seem very distant from *Ceratophrys* to me. They all have a wide beak and a stout body.

Two species, at least, *C. granulosus* Lutz and *C. eleutherodactylus* Miranda Ribeiro, are aggressive. *C. granulosus* can be lifted up by the fingers of a hand presented to it, which it will bite.

I do not draw any large conclusions from these observations, but I wish to point out the fruitful avenue of research provided by the observation of the living animal.

MUSEUM NACIONAL, RIO DE JANEIRO, BRAZIL.

A New Frog from Palestine

By HEINRICH MENDELSSOHN and HEINZ STEINITZ

TWO specimens of a species of *Discoglossus* apparently representing an undescribed form were found in March, 1940, on the east shore of Lake Huleh, Palestine. Two tadpoles caught at the same locality must be referred to the new species.

Discoglossus ***nigriventer,*** sp. nov.

TYPE.—Amphib. Discogl., No. 1, Collection of the Dept. of Zool., Hebrew University, Jerusalem, ♀ ; collected on the east shore of Lake Huleh (Northern District, Safed Subdistrict), March 22, 1940, by Heinrich Mendelssohn and Heinz Steinitz.

PARATYPES.—Tadpole, Amphib. Discogl., Nos. 2 and 2a. Same locality, August, 1940, collected by Heinz Steinitz.

DIAGNOSIS.—Differs from *Discoglossus pictus* in its greater interocular width, longer forelimbs, and less projecting snout; the ground color of the belly is dark, with small white dots, apparently much darker than in *pictus*. The tadpoles differ from those of *pictus* in having the nostril-snout distance less than that from eye to nostril, the mouth wider than the interocular space, and the width of the spiracle much less than that of the mouth.

DESCRIPTION OF TYPE.[1]—Head flattened, as wide as long; no canthus rostralis; nostrils rectangular with rounded corners, the distance between them (2.6) less than distance of nostril from eye (3.5); minimum interorbital distance (3.0) about equal to maximum width of eyelid; distance between tip of snout and nostril (2.3) less than distance between eye and nostril (3.5); tympanic membrane indistinct (somewhat more distinct in life), horizontal diameter (2.4) somewhat shorter than the vertical; diameter of eye (4.5) much greater than distance between tympanum and eye (3.0); snout projecting beyond the mouth (1.3); lower jaw bearing at its angle a process corresponding to a hollow in upper jaw. Choanae rectangular with rounded corners, more distinctly set off medially than laterally, longer side (0.6) lying

Fig. 1. *Discoglossus nigriventer*, type, from life.

exactly transverse, shorter side 0.3; distance between choanae 3.3; vomerine teeth 1.0 behind choanae, in straight, exactly transverse series, the right with 9 teeth, the left with 11; tongue (in life) roundish-triangular, smooth-edged, without furrows, entirely adherent except for a small margin. Fingers free; tips of fingers varying from round to pointed, in order of length, 1, 4, 2, 3; palmar tubercles white, the inner 1.6 long, the others 0.8 and 1.3 respectively; if legs are placed at right angles to the body the heels overlap; if hind limbs are brought forward the tibiotarsal articulation reaches the middle of the eye, the metatarsal articulation projects a little beyond the snout; foot a little shorter than tibia; toes not compressed, obtusely rounded, webbed at base (to somewhat different levels) in order of length 1, 2, 5, 3, 4; inner metatarsal

[1] Measurements in mm.

tubercle white (1.3). A glandular ridge extending from posterior edge of eye obliquely downward over the tympanum to the origin of forelimb; a second ridge from the same origin but at an acute angle to the first extends straight backward, splitting up into a number of glandular elevations at about the level of the shoulder girdle; entire dorsum dotted with glandular warts up to 1.0, single or in groups or rows. Total length (in life), 40.

Color in Life.—The main features of pattern are shown in Figs. 1-3; above ochre and rust colored grading into dark olive-grey; greyish-black below with numerous scattered white dots up to 0.8 in size at glandular openings.

Description of Tadpole.—Lips bordered by single series of papillae, interrupted in the middle of the upper lip; labial teeth 2/3; third lower series interrupted in the middle; first upper and first lower with one row of teeth, the other with two rows in No. 2; all series with two rows in No. 2a; tail tip obtusely rounded, muscles ending somewhat proximally, dorsal crest extending a little onto the back; network of adepidermal melanophores, visible everywhere; distance from nostril to snout about three-quarters the distance from eye to nostril; width of mouth once and a half the interocular space; width of spiraculum about a quarter of width of mouth.

Measurements of Tadpoles

	No. 2	No. 2a		No. 2	No. 2a
Total length	16.6	11.9	Spiracle to snout	3.6	..
Body length	7.2	4.7	Spiracle to vent	3.5	..
Body depth	3.1	2.5	Spiracle width	0.4	0.3
Body width	4.1	3.1	Eye to snout	1.4	0.9
Tail length	9.4	7.2	Eye to nostril	0.8	0.5
Tail depth at base	2.5	2.6	Nostril to snout	0.6	0.4
Tail depth, maximum	3.5	2.9	Mouth width	1.9	1.2
Musculature of tail	1.2	1.1	Interocular	1.2	0.9
Internasal width	0.7	0.6	Eye diameter	0.4	0.3

Remarks.—The genus *Discoglossus* has never been reported from the east shore of the Mediterranean. The species described differs in a number of characters from *D. pictus pictus* Otth, and from *D. pictus sardus* Tschudi, which are said by Boulenger (1897) and Schreiber (1912) to have short forelimbs hardly reaching the articulation of the hindlimbs; internasal space equal to distance from nostril to eye and to the interocular distance; and to have the ground color of the belly light. A second smaller specimen (27 mm.) was swallowed by the larger while the two were kept alive in a terrarium.

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The Pedagogical Institute for Biology, Tel Aviv, and the Hebrew University, Jerusalem, Palestine.

Notes on Jamaican Amphibians

By W. Gardner Lynn and James N. Dent

During the period from June 30 to August 20, 1941, the authors carried out investigations in Jamaica, B. W. I., concerning the embryology of *Eleutherodactylus*.[1] In the course of this work various collections were made that added two new species to the amphibian fauna of the island and provided new locality records for previously known forms. One of the new species has already been described (Lynn and Dent, 1942) and the other is described herein. Moreover, all new locality records, together with observations concerning the habits and habitats of some of the frogs, have been gathered together in this paper, which may thus serve as a supplement to the senior author's general account (1940) on the Jamaican amphibians.

Bufo marinus Linnaeus

The marine toad, introduced into Jamaica in 1844, is now wide-spread at elevations below 2500 feet. The present collections add three new localities for its occurrence: Highgate, St. Mary; Sandy Bay, Hanover and Quick Step, St. Elizabeth. The toads were not calling during the early part of the summer of 1941. They were first heard at Sandy Bay on the night of August 12. On August 16 they were extremely vociferous at Port Antonio although they had been silent when we collected there two weeks earlier.

Hyla septentrionalis brunnea Gosse

Another wide-spread species. Our collections furnish the first records of this tree-toad from the Cockpit Country. It was taken both at Accompong and at Quick Step, St. Elizabeth. We also have specimens from Dolphin Head Mountain in Westmoreland. Though the species does not occur on the Liguanea Plain its call was heard at Stony Hill, St. Andrew.

Hyla lichenata Gosse

No specimens of this interesting hyla were collected, but we are able to state positively that it occurs about Chapelton, Clarendon, where its unmistakable call was traced to clumps of bamboos. Such a habitat, although not previously recorded for this form, would seem to be a particularly favorable one for it.

Hyla wilderi Dunn

A good series was taken from bromeliads in the Cockpit Country near Quick Step, St. Elizabeth. The species was heard calling at Stony Hill on August 18. The latter record would indicate that it ranges much further eastward than had previously been believed.

1 Our work in Jamaica was supported by a grant from the Brooks Fund of the Johns Hopkins University, for which we desire to express our gratitude. We are deeply indebted to Mr. C. Bernard Lewis, Curator of the Institute of Jamaica, whose constant interest in our work was a source of inspiration to every member of our party and whose untiring aid, both in preparation for our expedition and all during our stay in the island, was in large measure responsible for the success of the trip. To the members of the Natural History Society of Jamaica we are indebted for the use of the Clydesdale House in the Blue Mountains as laboratory and living quarters. The drawings illustrating this paper are the work of Dr. Doris Cochran.

Eleutherodactylus ***fuscus,*** sp. n.

TYPE.—U.S.N.M. No. 115976, a male. Dolphin Head, Parish of Westmoreland, Jamaica, B. W. I., Aug. 12, 1941.

PARATYPES.—U.S.N.M. No. 115977, a male from the type locality. U.S.N.M. No. 115978, a male. Quick Step, St. Elizabeth, Jamaica, B. W. I., Aug. 9, 1941.

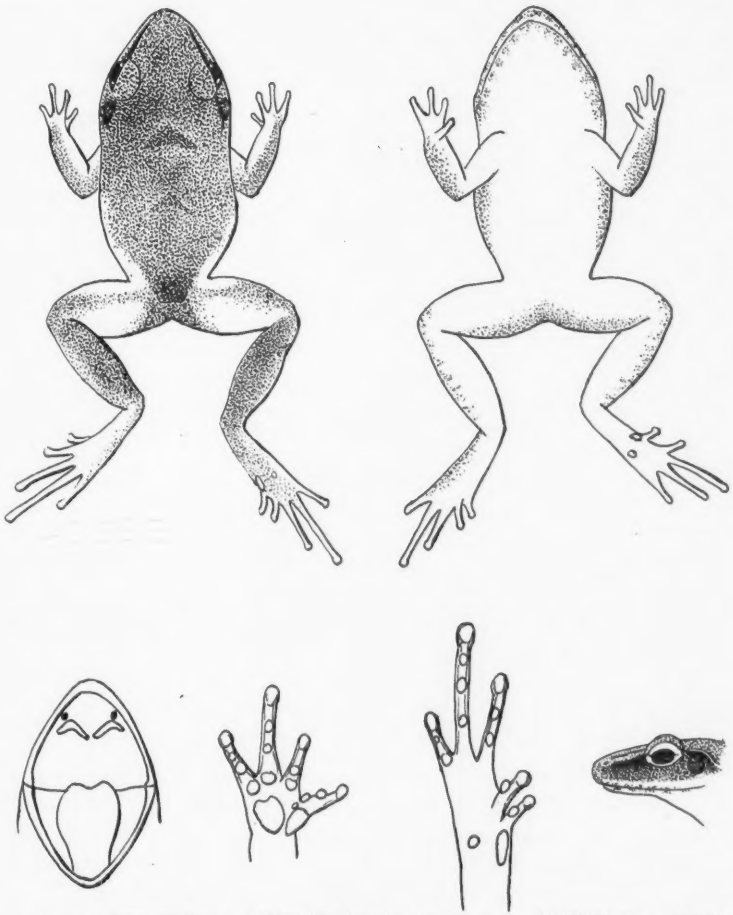

Fig. 1. Type specimen of *Eleutherodactylus fuscus,* sp. n. (U.S.N.M. No. 115976). Dorsum, venter, inside of mouth and profile of head × 1½; details of hand and foot × 3.

DIAGNOSIS.—A stout-bodied short-legged form with uniform gray dorsal coloration; vomerine series long; dorso-lateral line and marking poorly developed; no red in groin. This species resembles *E. pantoni* in its general

characters but differs from *pantoni* in lacking any ventral coloration or flash-marking in the groin and in having relatively short legs.

Description of Type.—Head broader than long; snout rounded; upper jaw projecting; tongue broad at free end, notched; greatest width of tongue two-thirds that of mouth opening; vomerine teeth in two long series extending laterally beyond the level of the choanae; the interval between the two series equal to one-sixth the length of one series; diameter of eye equal to distance from eye to nostril; nostril nearer to tip of snout than to eye; upper eyelid about one-half as wide as interorbital space; upper eyelid with a few small tubercles; diameter of tympanum about one-third that of eye; tympanum separated from eye by a distance equal to its own diameter; discs of fingers and toes not enlarged; first, second and fourth fingers all of equal length; no webs between fingers or toes; first toe much shorter than second; second toe shorter than fifth; subarticular tubercles prominent; two metatarsal tubercles; legs short, heels not meeting when legs are flexed with femora held at right angles to the body axis; knee and elbow not meeting when limbs are pressed along the sides; heel reaching tympanum when hind limb is extended along the body; back smooth except for two tiny warts above the scapulae; belly smooth; dorso-lateral line poorly developed; well-marked dark-colored glandular areas on posterior surfaces of thighs.

Dimensions of Type.—Tip of snout to vent, 30.0 mm.; greatest width of head, 13.0 mm.; tip of snout to posterior edge of tympanum, 14.5 mm.; diameter of eye, 3.5 mm.; diameter of tympanum, 1.2 mm.; fore leg from axilla, 16.0 mm.; hind leg from vent to tip of longest toe, 42.5 mm.; hind leg from vent to heel, 23.0 mm.

Colors in Alcohol.—Dorsal surfaces of body and limbs slate gray with no markings except a black line which passes from the eye over the tympanum and bends down toward the fore limb; ventral surface immaculate white; anterior and posterior surfaces of thigh straw-colored; palms of hands white; soles of feet dark.

Color in Life.—The colors in life were essentially as described above. There was no red in the groin. The colors of the paratypes agree very precisely with those of the type.

Call.—This species was first recognized as new by its call, which is a clear whistling "wick-wick" quite distinct from that of any other Jamaican form. Both specimens collected at Dolphin Head were traced by the call and taken while calling.

Eleutherodactylus lewisi Lynn and Dent

This species, recently described, was based on eight specimens collected at Dolphin Head Mountain, Westmoreland, on August 12, 1942. It is a small frog with enlarged digital discs, a long vomerine series and short legs.

Eleutherodactylus luteolus Gosse

New records for this abundant species are as follows: Stony Hill, St. Andrew; Penlyne Castle, St. Thomas; Highgate, St. Mary; John's Hall, St. James; Garland Grove, Portland; Chapelton, Clarendon; Cane River Falls, St. Andrew; Windsor, Portland.

Eleutherodactylus pantoni Dunn

This large and widespread form is distinguished from all other Jamaican eleutherodactylids by the yellow color of the belly in life. It was described by Dunn (1926) from specimens collected at Spaldings, Mandeville, Cumberland and Hollymount. These are all localities in the central highlands. Lynn (1940) later recorded it from Chester Vale, Green Hills, Arntully, Troy and Bath and noted that this extends the range to very near the eastern extremity of the island. The present collections make it possible to state that the species also occurs as far west as Dolphin Head in Westmoreland for specimens were taken at this locality, as well as at John's Hall, St. James, in the hills behind Montego Bay, and also in the Cockpit Country. We also collected specimens from near Corn Puss Gap, St. Thomas, in the region above Bath, and from Windsor, Portland, a village lying above Port Antonio on the road to Millbank. All of these collections were made at night and in the course of the work a rather astonishing phenomenon was encountered in connection with the call of this species. The call of *pantoni* is a very readily recognized one consisting of a sharp clucking sound which Dunn transliterated as "took" or "took-took." Our first experiences with *pantoni* were at Clydesdale at the western end of the Blue Mountain Range and here we learned that the call is almost invariably given in two syllables, "took-took" rather than as a single note. Later, on a trip to Corn Puss Gap near the extreme eastern end of the Blue Mountains we failed to hear the note of *pantoni* although several specimens were collected by the aid of the flash-light. We did note on this trip, however, a new call which we were not successful in tracing. This call was a rapidly repeated one that could be resolved in the syllable "took" repeated six times. Suspecting that the call might well be a local variant of the typical *pantoni* call we made a point of doing further collecting in the eastern mountains and were finally successful in actually collecting specimens which were giving this call. These were taken at Windsor which lies across the mountains from Corn Puss Gap. The call was also heard in the region of Portland Gap and near Abbey Green on the trail to Blue Mountain Peak and two females were taken with nests of eggs at the latter locality. We never heard the typical double call of the Clydesdale *pantoni* in these regions and the six-times repeated variant was common in all. It thus appeared that there is a local race of *pantoni* which inhabits the mountains from the region of Blue Mountain Peak eastward and which is characterized by a distinct call. Careful examination of all specimens from this area and comparison with series from the central mountains reveals only one morphological difference. All of the eastern specimens seem to have relatively short legs, the heels not touching when the legs are flexed with the femora held at right angles to the body axis. Specimens from Mandeville and the Cockpit Country have the heels touching or overlapping. However, at Clydesdale where the typical double call is given there are, in a series of 45 specimens, 18 with heels touching and 27 with heels not touching. There thus seems to be a gradation in this character as one passes from west to east. It also appears that the eastern specimens tend to have less yellow on the belly in life than do those from further west.

The story does not end here however, for when collections were made in the western portion of Jamaica still another variant of the call of *pantoni* was found. In the hills above Montego Bay and farther west, at Dolphin Head Mountain, one does not hear the double call but instead the call is given singly. Calling specimens were taken in both of these localities and there is no doubt concerning their identity. It has not been possible to find any morphological character which distinguishes these animals from Mandeville specimens.

It appears that we have here a case of the differentiation of quite distinct local variants in the nature of the call although there are no clear-cut morphological differences that distinguish the various types. The form giving a single "took" occurs in the western mountains in the parishes of Hanover, Westmoreland and St. James. The double call "took-took" was heard in the Cockpit Country, St. Elizabeth and Trelawney and is, of course, also typical at Mandeville in Manchester and at Spaldings, Clarendon, although in all of these localities a single call is not infrequently heard. The double call is the most frequent one given at Clydesdale, St. Andrew. Further east however, in St. Thomas and Portland, the six-times repeated call alone is heard and this is so distinct that it was some time before it occurred to us that it could be simply a variant of the *pantoni* call with which we were familiar. Further investigation as to the exact limits of these forms and study of the transitional zones would be of extreme interest.

Lynn (1940) reported the finding of a single nest of eggs of *pantoni*. This nest contained 104 eggs. We found two nests of *pantoni* eggs near Abbey Green, St. Thomas. One contained 86 eggs, the other 78.

Eleutherodactylus nubicola Dunn

Over a hundred specimens of *E. nubicola* were taken in the Blue Mountain chain between Catherine's Peak and Blue Mountain Peak. On Blue Mountain Peak the species was found up to 6200 feet, its range overlapping that of *E. alticola*, which occurs as low as 5600 feet. *E. nubicola* was not found below 3500 feet. Between July 1 and August 2 twelve clutches of eggs of this species were collected.

Eleutherodactylus cundalli Dunn

This has been recorded (Lynn, 1940) as one of the most widespread of Jamaican eleutherodactylids, occurring up to 4500 feet in the central mountains and all along the north coast. The present collections extend its range much further westward, to Dolphin Head, and provide the first record of its occurrence on the south coast. It is the only frog occurring on the hot dry limestones of Portland Ridge. Here it was found in deep caves, presumably the only places where there is sufficient moisture to enable it to survive. The cave specimens are very light gray in color, quite large in size and have a very tender skin that usually tears when the animals are captured. Other new locality records for *E. cundalli* are as follows: Abbey Green, St. Thomas; Chapelton, Clarendon; John's Hall, St. James; Dunn's River, St. Ann and Stony Hill, St. Andrew. Our specimens illustrate clearly the fact that, as Lynn (1940) has noted, specimens from the Blue Mountains

(3500 to 4500 feet) never reach as great size as do those from the western mountains and the coast. Our largest specimen, 43 mm. long, came from Dolphin Head, Westmoreland. The Blue Mountain specimens also differ from others in that they have proportionately smaller digital discs.

Eleutherodactylus grabhami Dunn

An extension of the range of this species to the Cockpit Country is provided by 36 specimens taken near Quick Step, St. Elizabeth, on August 8. The frogs were abundant on the ground in a region of honeycombed limestone where their mottled gray coloration afforded them considerable concealment. None were seen calling.

Eleutherodactylus ricordii Duméril and Bibron

Eleutherodactylus ricordii is a Cuban species which, it has been assumed (Lynn, 1940), has been introduced accidentally into Jamaica at a relatively recent date. It was first recorded from Jamaica by Lynn (1937) who took it at Montego Bay. Later, E. A. Chapin found the species at Hope Gardens in Kingston and it was supposed (Lynn, 1940) that this indicated two separate points of introduction. The present collections however, show that the species is wide-spread in the island and it may be that it has been in Jamaica for a long time. We took specimens at Sandy Bay, Hanover, at Highgate, St. Mary; near Port Antonio, Portland at Chapelton, Clarendon and Mr. L. V. Burns has recently taken the species at Hector's River on the border between Portland and St. Thomas.

Eleutherodactylus martinicensis Tschudi

This species was introduced into Jamaica in 1890 when specimens were released in the vicinity of Kingston. The story of this introduction was put on record by Barbour (1910), and, since the species had not been taken elsewhere than in the Kingston region, Lynn (1940) listed *E. martinicensis* as being "confined to the city of Kingston and its immediate environs" and regarded it as a form that, though it had become well established in its new home, had not succeeded in extending its range very greatly during the 50 years since its introduction. It was, therefore, with much surprise that we heard its note in the vicinity of Chapelton, Clarendon on the night of August 15. Though we succeeded in collecting only six specimens, the species was abundant there and this led us to suppose that *martinicensis* had, after all, been successful in extending its range across the 30 miles of hilly country which separate Chapelton from Kingston. However, several collecting trips to localities between Chapelton and Kingston soon showed that the species had no continuous range over the whole area and it was only through the efforts of Miss L. G. Perkins, a member of the Natural History Society of Jamaica, that the riddle was finally solved. It turns out that *E. martinicensis* has been introduced into Jamaica not once but several times, and at several isolated points. Miss Perkins (1942) has recently published a brief, but very valuable, note on this matter which we quote:

> With regard to the introduction and distribution of Whistling Frogs (*Eleutherodac-*

tylus martinicensis) in the parish of St. Ann, the following notes may be of interest. The information about their introduction was obtained from three people—two of whom were resident in the parish at that time, and one of these actually assisted in the liberation of the frogs on their arrival; the third came to the island shortly after in connection with two of the estates on which the frogs had been previously released, and heard them on his arrival. Since all these accounts agree with one another, and also with what I had gathered from various sources many years ago, I think they may be accepted as reliable.

The first introduction took place somewhere about the year 1890, when Judge Richard Reese (a Barbadian) brought, or imported, some Whistling Frogs from Barbadoes. A few of these he liberated in the grounds of a lodging house in East Street, the remainder at Pedro Farm in St. Ann.

About four years later, Mr. William Conran, a St. Ann landowner, on his way from England, stopped off at Barbadoes and collected some frogs of the same species, which he set free at Mt. Pleasant and Edinburgh Castle. It was then believed that they would exterminate the ticks which, before the days of dipping tanks, were giving the cattle breeders of the island serious concern. Some ticks were accordingly placed in the travelling container to serve as food, but, I am told that, on later inspection, they were found to be attached to the frogs!

At first the frogs gained ground very slowly, but now they seem to be spreading rapidly enough. The village of Golden Grove, near Claremont, is approximately midway between Mt. Pleasant and Pedro Farm, being about five or six miles from each place. The frogs, spreading from both directions, had not, up to fairly recently, reached the meeting point although they were nearing it. They have thus taken between 40 and 50 years to spread about 6 miles.

Their distribution to other parts of the parish has taken place in various ways. Four years ago, one which had hidden in a motor car whilst it was laid up for repairs at Claremont, got carried to Lumsden, over five miles away, and there escaped into the garden. The occupants of the house heard its solitary whistle around the grounds all during that time. This summer at their request, I sent four more to join it.

At Riverhead, near Ewarton in St. Catherine, a few miles from the St. Ann border, a solitary frog was also heard for a couple of years. This year pimento leaves were being taken over by truck from the Claremont areas for the manufacture of pimento oil, and, presumably, some Whistling Frogs made the journey among the leaves, for several more have been heard since.

In a few instances they were purposely taken to other localities when the belief was current that they would help to overcome the tick nuisance. I am told that they are to be found in the Dry Harbour Mountains in the western section of the parish, many miles from the points where they were first introduced.

The spread of the frog to Chapelton is thus clearly to be derived from its introduction in St. Ann rather than from its introduction at Kingston and Miss Perkins is to be congratulated upon the care and enthusiasm with which she has gone about unravelling this problem.

Eleutherodactylus jamaicensis Barbour

An inhabitant of the "wild pines," this species has been recorded at elevations from 1500 to 4000 feet in the central portion of the island from the region of Mandeville as far east as Catherine's Peak. The present collections considerably extend its range for we have specimens from the neighborhood of Bath in the east and from the Cockpit Country in the west.

Lynn (1940) has noted that "this species has never been observed calling and in all probability it is a silent form." We did not observe any specimens calling but have, nevertheless, some reason to believe that a clear call which we at first took to be that of some night bird really pertained to *jamaicensis*.

We first heard the call near Corn Puss Gap above Bath and were able to trace it quite definitely to particular branches of trees.

Upon revisiting these trees in the morning we found that the branches we had marked had "wild pines" growing upon them which yielded only specimens of *E. jamaicensis*. This experience was repeated in the Cockpit Country when we collected there.

Eggs of *E. jamaicensis* at the hatching stage were collected in a bromeliad near Corn Puss Gap on July 26. A clutch taken at Quick Step, Westmoreland, on August 8, contained 28 eggs in which the embryos were in an early, unpigmented stage.

Eleutherodactylus alticola Lynn

Described by Lynn (1937), this species has thus far been known only from the 25 specimens upon which the original description was based. We collected 151 specimens and 78 clutches of eggs in four days collecting in the region of Blue Mountain Peak and are, therefore, able to add much to our knowledge of the species. No call has been recorded for this frog but we found it giving a very faint chirping from amongst mosses on Blue Mountain. The same call was heard at elevations above 6000 feet on High Peak. Collections all along the trail to Blue Mountain Peak indicated that *E. alticola* does not occur below 5600 feet and is most abundant above 6000 feet. It is common at the very top of the mountain (7300 feet) and many clutches of eggs were taken from a rock pile beside the cabin on Blue Mountain.

Our collections were made on July 14 and 15 and on July 30 and 31. On both trips eggs in all stages of development from cleavage to hatching were found. The eggs require at least three weeks for their development, for eggs which were in cleavage on July 14 had not yet hatched on August 4 when we left the mountains. Of the 78 clutches which were collected, 75 were intact so that the eggs could be counted. It was found that the number in a clutch varied from 8 to 41 and averaged 23.

Study of these specimens reveals that this species shows much greater variation in its color and pattern than was indicated in the original description. Two quite distinct patterns exist in about equal numbers. In one there are broad lateral stripes extending from the snout to the groin, in the other no such stripes occur and the dorsal coloration may be either uniform or mottled. There is frequently a thin mid-dorsal light stripe in both types. One character, often regarded as diagnostic, is quite variable in this species. This is the red flash-marking in the groin. Some specimens have a very distinct red splotch in the groin, others have a faintly tinged splotch while still others have no sign of any color in this region.

It must also be noted that, although most specimens have very short vomerine series, others do occur in which the vomerine series would be described as of medium length or even as elongate.

Eleutherodactylus orcutti Dunn

We took 82 specimens of *E. orcutti* from the streams about Clydesdale, St. Andrew, but did not succeed in learning anything of its breeding habits.

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DEPARTMENT OF BIOLOGY, THE CATHOLIC UNIVERSITY OF AMERICA, WASHINGTON, D. C., and THE JOHNS HOPKINS UNIVERSITY, BALTIMORE, MARYLAND.

Field Notes on a Red Rattlesnake in Lower California

By LLOYD TEVIS, JR.

WHILE on a motor trip through Lower California in 1941, from which I have drawn up my herpetological notes for separate publication, I had the opportunity to watch the hunting and feeding behavior of a red rattlesnake (*Crotalus ruber*). This was on June 5 and 6, 18 miles north of Rosario, Lower California, in a region termed by Grinnell (1928) a humid desert, because of its high atmospheric humidity and meager rainfall. At the time of my observations there was warm sunshine in midday, a high fog in the morning and late afternoon, and at night a low fog that sometimes became a chilling drizzle. Vegetation consisted of an 18-inch ground cover of annuals and bushy plants plus occasional cholla, maguey, and club-like *Opuntia*. Except for tarweed, which was in full bloom, the annuals were dead and dry. The soil was light colored, but the few scattered rocks were brick-red. The white-footed mouse (*Peromyscus maniculatus*), wood rat (*Neotoma*), kangaroo rat (*Dipodomys*), and antelope squirrel (*Citellus leucurus*) predominated among the small mammals of the area.

On June 5, at 10:20 A.M. a young squirrel appeared suddenly at my feet much frightened. Forty-five feet away I found a red rattlesnake, an individual 37 inches long with nine rattles. The body color was red-brown and the short tail was barred with alternating coal-black and light-gray rings. When the snake realized I was not pursuing, it coiled deliberately on the dried annuals beside an adjacent squirrel runway. It was difficult to see, for its color blended with the tawny color of the dried vegetation and the bright tail was hidden beneath the body. Had it coiled on the bare ground or on the green foliage and yellow flowers of the tarweed, or had it not hidden its tail, it would have been conspicuous.

The bark of an adult squirrel 50 feet distant was ignored. At 10:35 the sun broke through the fog; the air warmed rapidly. Twenty minutes later the snake pushed off through the vegetation, head raised, tongue flickering, and the vertical black rings of the tail in startling contrast to the vegetation. Coming to one of the five holes of a squirrel burrow it inserted its head for ten seconds while flickering the tongue against the walls, then withdrew to crawl along a runway to another hole partly covered by a cholla. After again inserting the head and flickering the tongue, the snake entered.

Three young squirrels suddenly and simultaneously hurtled out of a hole on the opposite side of the cholla. They were bewildered, nervous, and held their tails tightly over their backs. Even though they saw me, they would not return to the burrow, and ultimately they hid under vegetation.

Ten minutes later I located the snake; it was inside the shaded hole from which the squirrels had fled. Its neck was bent into an S-coil, and its head, facing outward at the entrance, was pressed against the ground, motionless, an excellent simulation of a brick-red rock. For at least three and one-half hours the snake did not move. In other words, over the warmest part of the day it rested in shade at a spot that might yield food. Sometimes I saw the young squirrels. They stayed in the vicinity, barking, hiding under brush, and, peculiarly enough, running in and out of holes other than the one in which the snake rested.

By 3:24 P.M. the snake had moved 8 feet, and was now hidden among the dead annuals, neck in the S-coil, and head pressed onto the ground one inch from and facing a hole. A young squirrel frightened by me ran to the hole. The snake struck. Its jaws seized the squirrel by the hindquarters. The latter gave a single, shrill, somewhat choked scream, struggled for five seconds, then became quiet. Two minutes after the strike the snake relaxed but did not release its hold. The squirrel again struggled, weakly; only the front parts were able to move. As soon as the squirrel's rapid, forced breathing ceased, the snake began swallowing the hindquarters. Large gulps were separated by four to five-second intervals of rest. After one minute the squirrel's hind feet disappeared between the jaws. For four minutes thereafter the snake yawned frequently, exposing the saliva-filled pink mouth and the loosely hanging flesh-sheathed fangs.

Instead of resting, it crawled off, apparently eager for more food. I was able to keep it in sight off and on for three-quarters of an hour. Although it was continually on the move and usually avoided bare spots, it never went outside a 25 foot circle that included the burrow system. Right-angled turns were frequent. Sometimes it pushed under vegetation only to withdraw and

head in the opposite direction. Other times when under cover, it raised the anterior part of the body until the head was clear. Once it crawled over a bush to a height of a foot and a half above the ground. The ever-flicking tongue again and again quivered against stalks of dry annuals and touched objects, such as rocks. Bushes were probed with the head, the neck raised.

Whenever the snake came to a hole, the head was inserted for about ten seconds, and the tongue flickered against the wall. Twice after such an examination, the snake entered the hole to stay below ground for five or more minutes. Deliberate in its movements and ever intent and alert, the snake gave the impression of reconnoitering or searching. Undoubtedly it was trying to ascertain the whereabouts of the remaining squirrels. Noble and Schmidt (1937) found that blindfolded and tongueless crotalid snakes with unimpaired facial pits will strike at a freshly killed rat but not at a chilled rat, and conclude that crotalid snakes detect the body heat of their prey at a distance by means of the facial pits. Bogert (1941) found that a tongueless rattlesnake does not assume the defensive position it ordinarily does when confronted by certain odorous substances present in the integument of its enemy, the kingsnake, which shows that the tongue is used in the detection of odors. I assume that the snake I was watching inserted its head into the holes and flickered its tongue against the walls in order to determine by the presence or absence of body heat and odor whether or not a squirrel was below.

At 4:10 the fog returned. At 4:18 the air was cooling rapidly. At 4:45 the snake again entered one of the holes. Presumably it remained within, for I was not able to locate it until 11:15 A.M. the following day.

With the sun out in full force on June 6, the snake was coiled on dried vegetation in the shade of a bush not more than 20 feet from the spot where last seen. Because its body was swollen and because I did not see or hear a squirrel all day I concluded later that the snake had cleaned out the colony of young squirrels. At 2:55 P.M. it began reconnoitering movements as of the previous afternoon—circling, backtracking, examining objects, and inserting its head into holes—but, as would be expected if no squirrels remained and the snake by its investigation could tell whether or not a squirrel was below, it did not enter a hole. Once it inserted its head, flickered the tongue against the walls, withdrew the head, then seemingly unsatisfied, again inserted it. At 3:20 it curled its body around the base of a bush and rested, tongue inactive and head on the ground.

I then threw to it an immature kangaroo rat that had been live trapped. The latter landed almost on the snake's head. The snake, startled, jerked its head back to the striking position and for the only time during these observations rattled, giving only a feeble rattle for about a second.

As the rat had landed facing the snake there was but half an inch between their respective noses. The rat crouched for ten seconds. Neither it nor the snake moved. Each had its eyes fixed on the other. Then the rat whirled 180° and bounded off. But the snake was faster. The head shot forward 6 inches, the fangs struck the rat's hindquarters, and the head snapped back to the original position. At first I thought the rat was uninjured; it neither screamed nor leaped into the air, merely hopped on slowly for 3½ feet. Stopping, it sat up on its hind legs in an unconcerned manner and bent the head down as though going to lick the perineum. But then it straightened out and

wobbled forward a few inches: the hindquarters were paralyzed. It fell onto its left side. The body underwent slight convulsions. There was no struggle and apparently no agony. Death occurred two and one-half minutes after the strike.

Meantime the snake waited, but was alert. Its head and neck were off the ground and swaying from side to side, the jaws sometimes opening and shutting, and the tongue flickering. Approximately two minutes after the strike the snake started in the direction of the 4-foot distant rat hidden by intervening vegetation. When 1 foot from the rat, which was then in full view, the snake turned head and neck to face the opposite direction, tongue flickering.

I thought that the snake, sated with food and therefore not interested in the rat, was going to move elsewhere. But instead, swinging the head and neck back around and resuming forward movement, it went directly to the rat. This action indicated that the snake located its dead prey not by sight but by following the body heat or odor, or both.

Its neck raised and head bent downward, the snake flickered its tongue along the rodent's pelage from the base of the tail to the nose, back to the tail, and again to the nose, which was then engulfed by the jaws. As at each gulp the snake's head pushed forward three-quarters of an inch to force the rat deeper into the mouth and throat, the snake, in order to get the necessary slack, frequently had to draw its own neck backwards into an S-curve, dragging the rat's hindquarters on the ground.

The hindfeet disappeared between the jaws six minutes after the swallowing commenced; the tip of the tail one minute later. Again there was a short period in which the snake rested and at regular intervals yawned. A particularly wide yawn of three seconds was followed by the snake moving off, after which, stretched out full length, it rested in dead vegetation for at least three-quarters of an hour.

When I returned to the spot at 5 P.M., the fog having closed in, the snake was nowhere to be seen. I assume that again in response to lowered temperature it had gone underground for the night.

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Museum of Vertebrate Zoology, University of California, Berkeley, California.

The "Release" Mechanism and Sex Recognition in *Hyla andersonii* [1]

By Lester R. Aronson

THE mechanism whereby the male releases the female at the termination of oviposition has been studied in the leopard frog, *Rana pipiens*, by Noble and Aronson (1942). They concluded that the release was probably due to a series of factors including (1) the ejaculations of the male, (2) reduction in the girth of the female, (3) cessation of the female's abdominal contractions, and (4) the movement of the female out of the egg-laying posture.

The present study [2] was undertaken to determine the post-oviposition release mechanisms in *Hyla andersonii* Baird, a form whose oviposition consists of a series of repetitious movements extending over a period of several hours, and in which, therefore, the above factors described for *pipiens* cannot readily function.

Material

Two calling males and one gravid female were collected on May 18, 1940, in the vicinity of Lakehurst, New Jersey, by Dr. G. K. Noble. They were brought into the laboratory two days later and placed in a 15 gallon mirror-bottomed aquarium containing 2 inches of water and a few blades of grass. One of the males started calling immediately, and amplexus occurred shortly thereafter. The first part of the oviposition was not observed, but continuous observations were made of the last half hour of the egg laying. These frogs were then used to study the mechanism of sex recognition.

Oviposition

The pattern of oviposition followed in general the description of Noble and Noble (1923). Amplexus (Fig. 1a) was supra-axillary. The hind limbs of both the male and female were fully flexed. The tip of the male's mouth was slightly caudad to the posterior level of the female's eyes.

The female initiated the oviposition (Fig. 1b) by extending her hind limbs—knees directed outward—and by depressing her back. This had the effect of raising her pelvis and of turning the cloaca upward. A definite abdominal contraction was associated with these movements, and an instant later, eight to ten eggs were extruded from the cloacal lips of the female.

The male, apparently stimulated by these motions of the female (Noble and Aronson, 1942): (1) partially extended his hind limbs—knees directed somewhat downward; (2) slid forward so that the tip of his mouth was almost on a level with the mouth of the female, and; (3) arched his back convexly. These motions resulted in the male's cloaca sliding forward past

1 The Sexual Behavior of Anura: III.

2 This study was supported by a grant from the Committee for Research in Problems of Sex, National Research Council. The author wishes to acknowledge the assistance of Mr. Henry Dugas in making the observations, of Mr. Sidney Aberman for the drawings, and expresses his appreciation to Dr. Frank A. Beach for reading and criticizing the manuscript.

the female's at the instant that the eggs appeared. It is most likely that sperm was emitted at this instant.

The female then straightened out the curve in her back, lowered her pelvis and cloaca, and flexed her legs, while the male slid back to his normal amplexus position. In doing so, he pushed the eggs from the female's cloaca (Fig. 1c). The eggs fell to the substratum and scattered. It was estimated that this entire process took about one second.

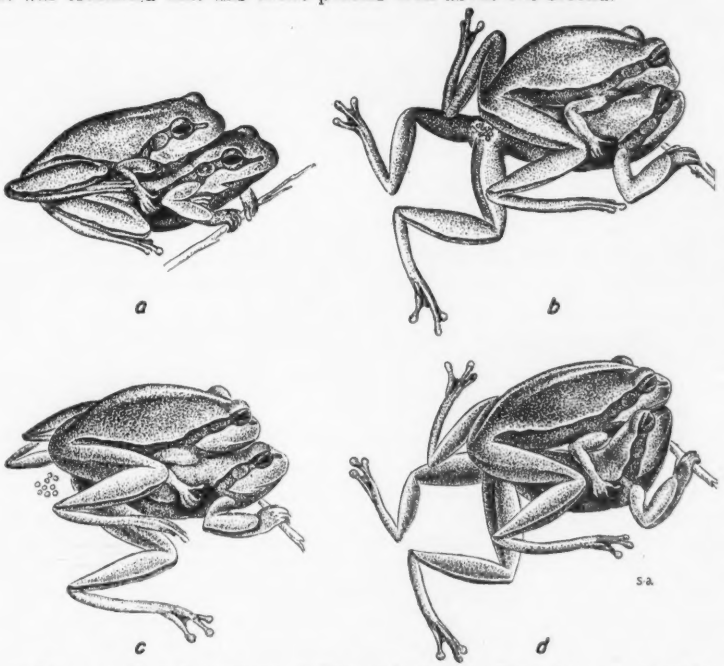

Fig. 1. a. Normal amplexus of *Hyla andersonii;* b. First phase of oviposition; c. Second phase of oviposition; d. The back depression release mechanism.

Following each oviposition, the pair usually rested quietly for a time. A period of active movement immediately preceded most of the egg layings. Occasionally two or three ovipositions followed in rapid succession.

Release

The above process was repeated over and over again for more than one-half hour, as hundreds of eggs were scattered throughout the tank. Suddenly the female depressed her back to a greater extreme (Fig. 1d) and held this position for more than a second (considerably longer than during the oviposition movements). No eggs appeared. The exaggerated down curve had the effect of partially raising the male from the back of the female. The male executed only a short incomplete oviposition movement. Two seconds later, he released, and soon after, started calling vigorously.

Sex Recognition

Post amplexus sex recognition in *Rana,* and the discrimination of the gravid from the spent female, were found by Noble and Aronson (1942) and others to depend upon (1) the warning croak and, (2) the girth of the individual being clasped. In the present study comparisons were made with *Hyla andersonii.*

Attempts to induce the calling male to clasp the now spent female were unsuccessful. When the female was injected intraperitoneally with 6 cc. of physiological saline solution, the male clasped tightly. Within one to two minutes the female depressed her back strongly as described in the previous section and the male released. This experiment was repeated five times. On one occasion the female repeated the downward curving of her back after the male had released. When the experimenter held the forelimbs of the male on the back of the female, she again curved her back downward.

Attempts were made to induce the calling male to clasp a second male, but each time one male was placed on the back of the other, the latter sounded a croak almost like the sex call, but lower and faster. This has been termed the warning croak (Noble and Farris, 1929: 15). We believe that it is one factor causing the clasping male to release.

Discussion

While there are outstanding differences in the sex-recognition mechanism between the frogs of the genus *Rana* and those of the genus *Hyla,* the basic pattern appears to be similar, involving chiefly the warning croak and small girth, both of which are factors causing release. The warning croak is not peculiar to *Hyla andersonii.* Using the techniques herein described, we have been able to induce a similar type of croaking in *Hyla cinerea, Hyla crucifer* and *Hyla versicolor.* The female, however, is silent; and if the clasping male is excited enough he may hold on to a spent female despite her small girth. In this event another effective mechanism is utilized by the female to rid herself of the male, namely the extreme depression of the back. This is not limited to the hylas; similar behavior was observed in *Bufo americanus* (Aronson, MS in preparation). Liu (1931), studying the behavior of *Rana nigromaculata,* noted a peculiar stretching of the female's back which he believed caused the male to release. It is thus conceivable that the back-depression response is a primitive mechanism that has been replaced in some of the specialized species of *Rana.*

Summary

1. The mechanism involved in the male's release of the female at the termination of oviposition in *Hyla andersonii* is an exaggerated, downward curving of the female's back that partially lifts the male off the female.

2. Post-amplexus sex recognition depends upon the warning croak and girth of the individual being clasped. The emission of this croak by a frog with a small girth causes a clasping male to release.

3. Discrimination of a gravid from a spent female is accomplished after amplexus. The spent female will dislodge the male by an exaggerated

downward curve of her back. The small girth of the spent female is also a factor causing release.

4. The warning croak of the male is common to many species of the genus *Hyla*.

5. The "back curve release mechanism" is also found in *Bufo americanus*, and may also be present as a primitive pattern in *Rana nigromaculata*.

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Herpetological Notes

PSEUDEMYS SCRIPTA TROOSTII IN MICHIGAN.—During the past several summers small collections of amphibians and reptiles have been made in the area about 16 miles north of Muskegon, Muskegon County, Michigan. Among these specimens is a single young *Pseudemys scripta troostii* (Holbrook), captured July 28, 1941, in Crystal Lake (No. 21 in my personal collection). An additional specimen in Field Museum (FMNH 6450) was taken in Crystal Lake in 1924. Each year the Boy Scouts, who have camps on Crystal Lake, are said to get several specimens, but I have unfortunately been unable to obtain any from them for verification.

If this were merely an extension of the range of this form which is known from the Kankakee River Drainage in Indiana, it should occur in Michigan south of Muskegon, but the Herpetology of Michigan (Ruthven, Thompson and Gaige, 1928, Univ. Mich. Hdbk. 3) does not report it from the state, nor has it been found by Dolley (1935, Amer. Midl. Nat., 14, (3): 193–227) or by myself (1942, Copeia: 180). It seems evident that the species was introduced at Muskegon, no doubt at the Boy Scout Camp. My juvenile specimen, not more than three years old, appears to indicate that this turtle has established itself in the county.—Richard A. Edgren, Jr., *4722 Manor Ave., Chicago, Illinois.*

NOTES ON REPTILES FROM MEXICO.—Six species of reptiles from Mexico in the collection of the University of Rochester are of more than casual interest since they extend the known ranges of two species and furnish important variational data for the rare skink *Eumeces parvulus* Taylor.

Phyllodactylus lanei Smith.—Three specimens (Nos. 5370–5371, 5382) are from Compostela, Nayarit. They cannot be referred to any other species described at present from Mexico. *P. lanei* seems to have a wide distribution in western Mexico, from southern Sinaloa to central Guerrero, and eastward in the Balsas Valley in Michoacán.

Anolis nebulosus Wiegmann.—Two specimens, one from Compostela, Nayarit (No. 5381), the other from La Venta, near Acapulco, Guerrero. In each the dorsal scales are markedly smaller than the ventrals.

Holbrookia elegans thermophila Barbour.—One specimen (No. 5869) is from 8 miles south of Nogales, Sonora, collected by Dr. S. C. Bishop. It is a young male, measuring 37.5 mm. snout to vent, tail 39 mm.

Eumeces parvulus Taylor.—In 1936 (Kans. Univ. Sci. Bull., 23: 363–367), Taylor cited three known specimens of this species, from Plomosas, Sinaloa, Tepic and Minimán, Nayarit. In 1937, Oliver (Occ. Pap. Mus. Zool., Univ. Mich., 360: 12) reported another specimen, from Paso del Río, Colima. Accordingly, two in the University of Rochester collection (Nos. 5383–5384) are the fifth and sixth known specimens of this rare species. They are from Compostela, Nayarit.

The larger specimen (No. 5383) measures 50 mm. snout to vent; it has 22 scale rows around the middle of the body; the frontal is broadly in contact with frontonasal, and narrowly in contact with the third supraocular; the interparietal is but slightly longer (1.8 mm.) than wide (1.6 mm.); and between the faint lateral stripes of either side there is a median brownish olive area occupying six and two half scale rows; otherwise as described by Taylor.

The smaller specimen (No. 5384) measures 31 mm. from snout to vent; it has 24 scale rows around the middle of the body; frontal broadly in contact with frontonasal and completely separated from third supraocular (frontoparietal in contact with second); interparietal a little wider (1.3 mm.) than long (1.2 mm.); 6 and two half scale rows between lateral stripes in middle of body; and lateral dark stripe very broad, covering about four and two half scale rows, but without well-defined edges; otherwise as in Taylor's description.

Taylor (*op. cit.*: 367) suggests that a specimen from Plomosas, Sinaloa, may represent a species different from the others, and lists its peculiarities. The present specimens independently show a number of these peculiarities: one has 22, instead of 24, scale rows in middle of body; one has the interparietal broader than long; and one has a very distinct lateral dark line. Since the latter specimen is small and the Plomosas specimen also is small (8.5 mm.) it is suggested that the distinct lateral stripe is a juvenile character, lost in adults. It thus appears that the correctness of the association of the Plomosas specimen with *parvulus* can no longer be doubted.

Imantodes latistratus Cope.—One specimen, No. 5379, from Compostela, Nayarit, extends the known range of this species northward from Michoacán. Werner's record (1908, Mitt. Nat. Hist. Mus. Hamburg, 26: 229–230) of *Imantodes gemmistratus* from Hacienda de Ixtapa, Tepic (= Nayarit) does not seem referable to this species, since the bands are described as very much broken posteriorly and a little wider on neck than spaces between. In the present specimen, as in other *latistratus*, the anterior bands are about three times as long as the interspaces, and those on the posterior part of the body become indistinct but not broken up. Scale rows 17–17–15; ventrals 229; caudals 109; temporals 1–1–2, other head scales indistinguishable; total length 466 mm., tail 62 mm.; female.

Leptodeira annulata polysticta (Günther).—A male specimen (No. 5379) from Compostela, Nayarit, extends the known range of this species northward from Colima. It is typical, with 21–23–15 scale rows, 206 ventrals, 96 caudals, 8–8 supralabials, 11–11 infralabials, 3–3 preoculars, 2–2 postoculars, 1–2–2 temporals, and 54 spots.—HOBART M. SMITH, *University of Rochester, Rochester, New York.*

THE VALIDITY OF *CROTALUS VIRIDIS DECOLOR* KLAUBER.—In a recent article in COPEIA (1942, (4): 258) Dr. A. M. Woodbury contends that *Crotalus concolor* Woodbury (1929, Bull. Univ. Utah, 20: 3, figs. 1, 2) is a valid name and is not suppressed by an identical varietal name (*C. durissus* var. *concolor*) first used by Jan (1859, Rev. Mag. Zool., ser. 2, 10: 1883, 153) and later placed in the synonymy of *Crotalus horridus* by Garman (Mem. Mus. Comp. Zool., 8: 175) and by Stejneger (1893, Ann. Rept. U. S. Nat. Mus.: 427). These reasons cannot be considered valid.

Woodbury states that Jan's *concolor* is a *nomen nudum* and that therefore the identity of the Munich specimen on which Jan's name was based has no bearing on the case. With this I agree, although the point is open to some question, since Jan did characterize that "variety," and seven other species and varieties together, as having rattles, entire subcaudals, small dorsal head scales and enlarged supraoculars. Since there was no *separate* characterization of *concolor*, or any other included in the same group, however, the requirement of Article 25a of the International Rules can be regarded as not having been met. Accepted as a *nomen nudum*, of course Jan's name and his specimen have no significance whatever taxonomically; so considered, under no circumstance can the species name be attributed to Jan. The name can be made available, after 1859 as before, for any *Crotalus*.

Garman's citation of *Crotalus durissus concolor* Jan in the synonymy of *Crotalus horridus* therefore must be considered vital to the definition of the name; the reference to Jan means nothing. The requirement of Article 25a is met without question, for Garman includes a good description of *Crotalus horridus;* therefore, for the first time, the name *concolor* becomes available in *Crotalus*. Since the synonymy, in this case as always, lists names which are considered by the author to apply to the species described, any new name included is definitely fixed with the described species. I cannot believe any other interpretation can be defended. Obviously the proposal of a new name by Garman was inadvertent and unintentional, but that does not call for suspension of the rules. An author's intention, regardless of its nature, has no significance *providing the rules adequately cover the situation*, as they do in the present case. When rules are inadequate intention is of course important.

Opinion 5 of the International Commission (that a "name, ineligible because of its publication prior to 1758, does not become eligible simply by being cited . . .") would apply in the present case had Garman only cited the name; it does not apply since a description accompanied the citation.

It is my conclusion that *Crotalus durissus concolor* Garman is an available synonym of *Crotalus horridus horridus* Linnaeus, and that *Crotalus concolor* Woodbury is removed from availability by suppression as a homonym of the first. Gloyd (1940 Spec. Publ. Chicago Acad. Sci., 4: 216) correctly concludes that *Crotalus viridis decolor* Klauber must be the valid name for the faded rattlesnake described by Woodbury.—HOBART M. SMITH, *Department of Zoology, University of Rochester, Rochester, New York.*

NOTES ON AMPHIBIA OF THE CASCADE MOUNTAINS IN OREGON.—Early in August, 1942, a week spent on the portion of the Oregon Skyline Trail between Mt. Jefferson and Mt. Washington yielded certain observations on the fauna and flora of this vicinity. The area covered was just to the west of the summit of the Cascades, at elevations ranging from 4,000 feet to 5,000 feet. For identification of various species I have referred to *The Amphibia and Reptilia of Oregon* by Dr. Kenneth L. Gordon. My notes on Amphibia follow.

Triturus granulosus granulosus (Skilton); Oregon newt.—In Santiam Lake these salamanders tend to stay hidden in the rocks on the lake bottom. If not disturbed, they lie on the top of the flat rocks under water, and irregularly swim to the surface and just float there for a time, before going back down among the rocks. This form is also found in Jorn and Bowerman lakes.

Bufo boreas boreas (Baird and Girard); northwestern toad.—Many small individuals of this species, from ½ to 1 inch in length, were found along the trail to Big Lake. In pools and in the grass near the edge of Big Lake, there were thousands of these small toads up to ¾ inches long. These juveniles are nearly black or a dark brown, and do not possess the yellowish mid-dorsal stripe characteristic of the adult. Thousands of tadpoles in all stages of development were present in pools on the sandy bottom and

among grass stems near the edge of the lake. The young toads on land and the tadpoles in the water tended to "bunch-up" in clusters, until disturbed. I found this clustering taking place at any hour of the day. I did not find any eggs. During this time I saw only one adult. These toads were also seen at Santiam, Jorn, and Red Butte lakes. The ones at the latter lake had a rusty-red coloration dorsally.

Hyla regilla Baird and Girard; Pacific tree frog.—Several of these frogs were found at Big Lake, together with the northwestern toads. Egg clusters in the litter on the bottom, near the edge of the lake, were in jelly-like masses a little more than one inch in diameter. The egg diameter might be from 1/32 to 1/16 inch.

Rana pretiosa pretiosa (Baird and Girard); western spotted frog.—Two specimens of this species were taken in the grasses at the edge of Jorn Lake, where this form apparently meets the following.

Rana pretiosa luteiventris Thompson; Nevada spotted frog.—Specimens were taken in Santiam, Red Butte, Jorn, Bowerman, and Blue lakes. This was the predominant subspecies of the spotted frog in this area. Common along the edges of lakes.—FRED G. EVENDEN, JR., *Oregon State College, Corvallis, Oregon.*

HALDEA V. VALERIAE IN NEW JERSEY.—The first published record indicating the existence of *H. v. valeriae* in New Jersey was that of Miller (1916, COPEIA: 68), recording several specimens seen a number of years previously in the Watchung Ridges near Plainfield, New Jersey. Although he speaks of preserving one specimen, this is apparently no longer in existence. Blanchard (1923, Pap. Mich. Acad. Sci., 3: 361), in his revision of the snakes of the genus *Virginia,* cites one specimen of this species from Watchung, New Jersey, in the collection of the American Museum of Natural History (No. 18073). This is no longer to be found in the Museum collection.

We have carefully examined the detailed and meticulous notes of Waldron deWitt Miller, who collected for half a century in this area. In his notes for May 30, 1899, he wrote of finding two odd snakes under boards at the edge of Crystal Pond at the town of Watchung, which he was then unable to identify. These snakes were kept alive until September, when Miller showed them to Mr. Eugene Smith, who identified them as *Storeria dekayi,* despite the fact that the scales were smooth and in 15 rows. Miller was not satisfied with this identification and later noted in red pencil that he had finally determined them to be *Virginia valeriae,* a species new to New Jersey. In the notes for February 10, 1900, he added that he had previously found two similar snakes in the fall of 1898, at the same place.

A friend of Miller's, Mr. Richard Moldenke, became interested in snakes and collected around his home, Castle Elsinore, on the north side of the first Watchung Ridge, near the town of Watchung, from 1918 to 1924. During this time he caught about twelve specimens of *Haldea v. valeriae.* Of these, four are now in the collection of the American Museum of Natural History. These were taken under boards and stones, but chiefly in the deep window wells of the building.

The next specimen to come to our attention was taken under a piece of burlap in a pumphouse near the same building on July 29, 1936, by Mr. Fisher of Watchung; it was not preserved. During July, 1937, Mr. Samuel Clementi took another specimen in the quarry at Seeley's Notch near Scotch Plains, Union County, about 2 miles northeast of the previous locality at Castle Elsinore. This is deposited in the Cornell University Museum. In September, 1940, two young specimens of this snake were taken by Mrs. Frankie C. Goerges during the excavation of a drive on Melzer Road, Chatham Township, Morris County. This last locality is about 7 miles to the northeast of those previously mentioned and is at the base of Long Hill, the third Watchung Ridge. One of these specimens is now in the United States National Museum, the other in the collection of the Newark Museum, Newark, New Jersey. These are a male and a female of the year, the male being 96 mm. and the female 103 mm. in total length.

In the extensive collecting of Mr. Carl Kauffeld and his associates on the coastal plain of southern New Jersey and the widespread collecting of Miller and others over New Jersey generally, *Haldea v. valeriae* has not been found outside of the trap rock ridges (Watchung Mountains) of the Piedmont Plateau, where an isolated colony of this species apparently exists.—JAMES KEZER and HAROLD TRAPIDO, *Zoological Laboratory, Ithaca, New York.*

Ichthyological Notes

NOTROPIS MEARNSI FROM ARIZONA, AN ADDITION TO THE KNOWN FISH FAUNA OF THE UNITED STATES.—More than twenty-five years ago Snyder (1915, Proc. U. S. Nat. Mus., 49: 582–584, 1 fig.) described the first known species of the cyprinid genus *Notropis* from the Pacific drainage of northwestern Mexico. The five types were collected in 1893 in San Bernardino River, a tributary of the Yaqui River, in Sonora, Mexico, near the international boundary line. On September 10, 1943, James R. Simon collected in the headwater region of this stream about 17 miles east of Douglas, Cochise County, Arizona. Among the species taken were 6 half-grown to adult specimens of *Notropis mearnsi* (27 to 37 mm. in standard length). These fish were collected about 2 miles above the Mexican border in the east-central part of T. 24 S., R. 30 E., at an elevation of approximately 3800 feet (see U. S. G. S. Perilla Quadrangle, edition of 1919 reprinted 1920). They were seined in a small pool immediately below the spring which, according to local testimony, is the highest permanent water in the creek. This pool is used extensively as a water hole for cattle and is considerably fouled by them. A salting ground is nearby. On the date of collection the water was muddy over a bottom of gravel, sand, and boulders, the maximum depth was 5 feet, and vegetation was absent.

In the original description the dental formula was given as 4–5, or, as we write it, 5–4 (five teeth on the left side, four on the right), but only one paratype was examined. Later, Dr. Carl L. Hubbs found that the holotype and other paratypes have a formula of 4–4 and the specimens in the present collection exhibit this same number. The transfer of *mearnsi* to *Hesperoleucus*, made by Jordan, Evermann, and Clark (1930, Rept. U. S. Comm. Fish., 1928, Pt. 2: 122), no doubt on the basis of Snyder's dental formula, is thus untenable. The fifth tooth on one arch of the specimen examined by Snyder presumably represents a variation rare enough to be called an abnormality. With critical study, *mearnsi* may prove to be specifically inseparable from *Notropis lutrensis*, from which species or species-group it was probably derived. It is very obviously a *Notropis*.

Other fish associated with *Notropis mearnsi* in the 1943 collection were topotypes of *Catostomus bernardini* and *Gila purpurea* and specimens of *Agosia chrysogaster* and a species of *Poeciliopsis*. With the exception of the *Poeciliopsis*, none of these species was found in San Bernardino Creek between this headwater pool and a point about 2 miles below the international line in Mexico.—ROBERT R. MILLER and JAMES R. SIMON, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan,* and *U. S. Naval Training School, University of Arizona, Tucson, Arizona.*

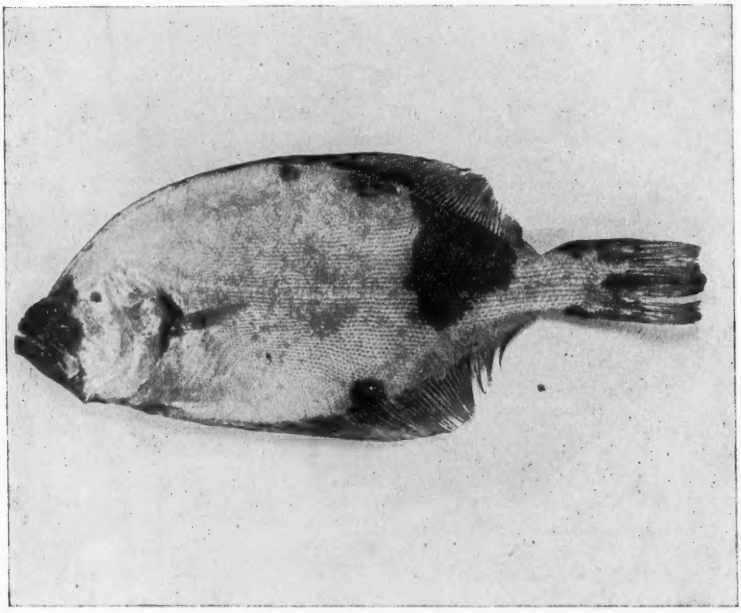
RECORD OF AN "ALBINO" LAKE TROUT, *CRISTIVOMER NAMAYCUSH NAMAYCUSH* (WALBAUM).—On September 15, 1943, a commercial fisherman, John Doyle of Alpena, Michigan, captured a partially albino lake trout on the Big Reef off Alpena in Lake Huron. The fish was sent to Mr. Fred A. Westerman of the Michigan Department of Conservation who kept it on ice for examination. Failure in transportation arrangements caused the loss of the specimen which was intended for the Museum of Zoology of the University of Michigan.

This lake trout was about 4 pounds in weight and normal in appearance except for the almost complete lack of black pigment in the skin. The color may best be described as pale golden yellow except for a space of about 3 inches on the back between the head and the dorsal fin where some melanophores were present. Except for this small area the general color was the same as in albino brook trout, strains of which are found at hatcheries and aquaria in several states. The eyes were of a somewhat deeper red than normal in albino brook trout but lacked any black pigment.

As far as can be determined, albinism in lake trout has not been previously reported and is believed to be rare in this species.—ALBERT S. HAZZARD, *Institute for Fisheries Research of the Michigan Department of Conservation, University of Michigan Museums Annex, Ann Arbor, Michigan.*

A COLORLESS SOUTHERN FLOUNDER, *PARALICHTHYS LETHOSTIGMA* JORDAN AND GILBERT, FROM TEXAS.—Several ambicolorate flounders have been described by Gudger and by Gudger and Firth in a series of papers (see Breder, 1938 Zoologica, 23(4): 393–395 and Gudger, 1941, COPEIA, 1: 28–30). Gudger (1936, Amer. Mus. Novitates, No. 897: 1–7) has described three specimens of the southern flounder, *Paralichthys lethostigma* Jordan and Gilbert, showing partial and complete ambicoloration. Lack of color is more rarely reported in the flounders. Breder (1938) has described an almost completely colorless specimen of the winter flounder, *Pseudopleuronectes americanus* (Walbaum).

The purpose of this paper is to record another flounder largely lacking in color. It is a southern flounder, *Paralichthys lethostigma,* which was caught in a shrimp trawl, at about the middle of Aransas Bay, Aransas County, Texas, on April 23, 1943. Mr. Ted L. Atwood, of Rockport, Texas, took the specimen and I am indebted to him for saving it and giving it to me.



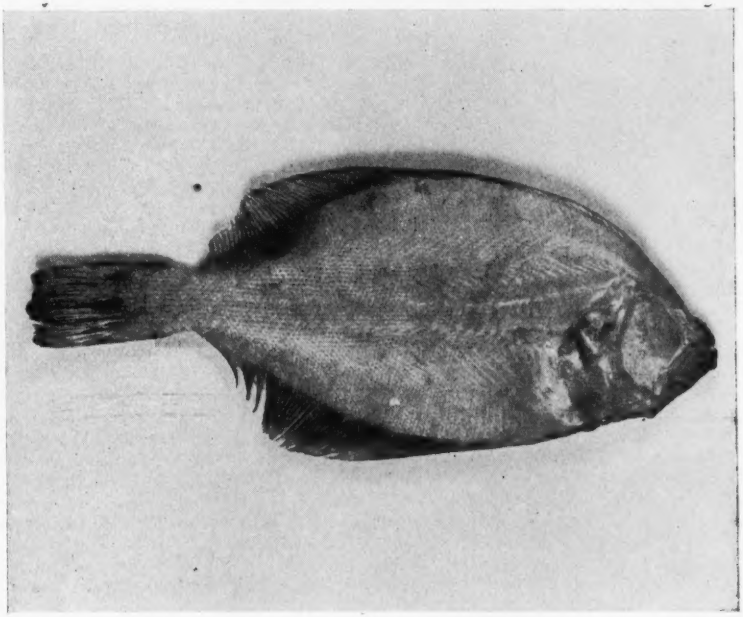
Eyed side of colorless southern flounder

The fish was 22.5 cm. in total length and 18.5 cm. in standard length. There were no external morphological aberrations and the fish appeared to be perfectly normal except for the lack of color on the eyed side. From the region of the eyes forward, the head was normally colored, except where the premaxillary, maxillary and mandible came together. The pectoral fin and a spot at its base were normally colored. The membrane and rays of about the anterior third of the vertical fins were abnormally light-colored. The rest of the fins were normally colored. There were irregular splotches on the body, which can be seen in the plate. The blind side was completely colorless except for a small spot on the posterior part of the body.

This specimen compares with Breder's colorless *Pseudopleuronectes americanus,* see plate (Breder, 1938, *op. cit.*), in having the head colored from the eyes forward and in

having the pectoral fin colored. Breder stated that the vertical fins of his specimen seemed to represent a paler phase than usual, but he thought this may have been due to the fact that the fish had been iced. My specimen was received fresh and the anterior parts of the vertical fins were definitely paler than usual, as stated above, but they were not completely lacking in color.

The twisting of the head of the Heterosomata is a process superimposed on the other growth processes of a bilaterally symmetrical fish. Abnormalities connected with this process are numerous, and Gudger (1935, Jour. Morph. 58(1): 1–39) states that the literature of the subject is "vast, inchoate, unclassified and undigested." Ambicoloration in flatfishes seems to be connected with the fact that the fish twists during development and Gudger has shown in a series of papers that morphological anomalies, especially of the head, often accompany ambicoloration in the flounders. On the other hand, lack of color in the flatfishes is probably related to albinism, such as occurs in many other animals, and unrelated to twisting of the fish during development. In that case there



Blind side of colorless southern flounder

would be no reason to expect lack of color to be accompanied by the morphological aberrations common to flounders. Breder's colorless winter flounder and the colorless southern flounder described here were both normal in other respects. More specimens will be needed to clarify the point.

The winter flounder had recovered from the bite of some predator, and Breder discussd lack of color in flounders in connection with their ability to survive. Colorless flounders may occur more often than records show, the fish not surviving to be collected. On the other hand, albinism is apparently very uncommon in fishes, although more is reported in the Heterosomata than in other groups (Gudger, 1937, Nat. Hist., 40(4): 649–652).—Gordon Gunter, *Game, Fish and Oyster Commission, Rockport, Texas.*

UNUSUAL SPAWNING HABITAT FOR THE COMMON WHITE SUCKER, *CATOSTOMUS C. COMMERSONNII*.—The common sucker usually spawns in the shallow swift waters of small streams over a gravel bottom (Reighard, 1920, Biol. Bull., 38: 1–32). In central New York the spring migration occurs in late April and May (Raney and Webster, 1942, Copeia: 139–148) and spawning ordinarily occurs at night in the moderately swift water of riffles. This holds especially for tributaries of the Finger Lakes and particularly for Cayuga Lake Inlet, Ithaca, New York. However, during the spring of 1942 when the water was unusually low in May, large lake suckers were observed spawning in quiet water at the lower end of an almost completely isolated pool. This further evidence of the adaptability of the common sucker, especially in connection with an activity so important for the survival of a species, is added reason for the wide distribution and general abundance of this species.

These observations were made in Cayuga Lake Inlet, one mile above the mouth of Buttermilk Creek. A large concentration of from 40 to 60 large lake suckers were virtually isolated in a large quiet pool. Short, narrow riffles, not over 3 feet wide and 6 inches deep sufficed for both inlet and outlet of this pool. These riffles appeared to be satisfactory as spawning sites except for their shallowness and lack of shelter under the adjacent bank to which the suckers might retire when frightened.

The pool where spawning was observed was from 50 to 60 feet wide and 200 feet long. It was deepest near the middle at the base of a large willow tree, whose roots served as an excellent shelter to which the suckers retired when molested. Both the upper and lower ends had a similar gravel bottom and were probably equally satisfactory as a spawning ground. However, only the lower end was utilized. Here the water varied in depth from about 4 feet in the middle to 4 inches near shore. On May 1, 1942, it was noted that several large patches of gravel in quiet water at a depth of 1 to 2 feet had an unusually clean appearance. Further observation revealed that these areas were the spawning beds of suckers. These spawning areas were extended, until by May 18 practically the entire lower end of the pool was being utilized. When breeding appeared to be at its height in midafternoon on May 18, the water temperature was 64° F., the air temperature 75° F. At this time there were from 10 to 20 large males from 12 to 18 inches long, cruising slowly about over the spawning beds which were mostly in water from 15 inches to 4 feet in depth. At this time a pronounced sexual dimorphism was noted. The males had a pronounced dark streak down the midside which was continued forward to encircle the snout. As observed in the water, this streak was black in most but was slightly reddish in a few. Just above this dark streak was another light yellowish or whitish streak of about the same width which also encircled the snout. The back above this light streak was black. The lower fins were light to faint yellow. Neither the intense dark lateral streak nor the light streak immediately above it occurred in the females.

Any sucker, whether male or female, which moved rapidly across the spawning grounds was immediately followed by the school of ripe males which attempted to crowd in from above and each side. A male or a female not quite ready to spawn, caught in such a situation, would beat a hasty retreat to the deep section of the pool. A ripe female which was ready to breed would swim out from the deep section of the pool, take a position over the gravel, and spawn while shaking vigorously when pressed from all sides by males lying parallel to her. A cloud of silt and sand was raised at the moment of spawning and the eggs were deposited singly or in small groups. After spawning a female would quickly retire to the seclusion of the deep water beneath the willow tree while the males continued swimming slowly over the spawning bed. The frequency with which a group of males would follow another male, especially a large one, suggests that sexes are recognized by behavior rather than by differences in color pattern. At times certain males would retire to deeper water but their place was taken by others, thus maintaining a total number of about 15. The largest number of males seen at one time was 26. When frightened by a quick movement of an observer they would all retire to the depths only to appear again in about five minutes. They paid no attention to a person standing quietly at the edge of the pool only 10 feet away. Many thousands of eggs were recovered by sifting the sand and gravel from the large spawning bed.—Edward C. Raney, *Department of Zoology, Cornell University, Ithaca, New York.*

ATLANTIC SALMON IN LAKE JESSE, NOVA SCOTIA[1].—In 1934 the fish population in Lake Jesse, Nova Scotia, was destroyed by treating the water with copper sulphate (Smith, 1935, Trans. Amer. Fish. Soc., 65: 101–114). The purpose was to make a lake habitat in which speckled trout fry or fingerlings could be planted with no predation or competition from other fish. In 1936 the lake was stocked with speckled trout fingerlings, and closed to angling until 1939. Fish were prevented from moving into or out of the lake by a barrier at the outlet. A creel census was taken during 1939, and this disclosed that an unknown number of Atlantic salmon (*Salmo salar* Linnaeus) had inadvertently been included with the trout introduced in 1936. In all, 49 salmon were taken by the anglers during April, May and June. These fish had an average total length of 32.6±0.27 cm., an average weight of 241±6.8 gm., and were in their fourth year of age.

The normal habitats of the Atlantic salmon during their life in fresh water are the coastal streams, not lakes; and in the streams they tend to occupy the rapids rather than the pools or still waters. Particular interest is therefore attached (1) to the ability of small salmon fingerlings to adjust themselves and survive in the relatively quiet waters of Lake Jesse, and (2) to the growth the fish made under such conditions.

The fingerlings were quickly transferred from the running water in the hatchery, where they had been feeding from two to eight weeks, to the still water of the lake. White (1933, Biol. Bd. Can. Atl. Prog. Rep., 7: 6–81) observed that salmon fry require a period of adjustment following a sudden change of this nature before their swimming movements become normal in still water. The adjustment appears contingent upon an enlargement of the lumen in the air bladder. Obviously such fish would be particularly vulnerable to predator action during this period, which is a matter of days, and it may be pertinent that the survival of considerable numbers of salmon in Lake Jesse was in a habitat that was free of predator fish. As the number planted is not known, the proportion surviving cannot be determined.

Most Atlantic salmon in Nova Scotia migrate to the sea as smolts at two (the majority) or three full years of age. The migration is usually in May. However, the salmon in Lake Jesse were prevented from migrating by the barrier at the outlet. If these fish would normally have gone to sea at two years of age, then it may be considered that when captured in 1939 they would have had a year of post-smolt growth. On May 8, 1938, a salmon smolt was taken by rod in Lake Jesse. This fish was two full years of age and had a total length of 11⅜ inches (28.9 cm.). On this evidence, the salmon in Lake Jesse would have gone to sea at two years of age, and the post-smolt growth was small compared to that which would have been made during the first year of sea-life. The same observation indicates that the salmon parr made rapid growth in Lake Jesse by comparison to that attained by two-year, or even three-year parr and smolts in Atlantic coastal streams (Belding, 1935, Trans. Amer. Fish. Soc., 65: 157–160; 1937, *ibid.*, 66: 211–224; Belding and Clark, 1937, *ibid.*, 67: 184–194; Kendall, 1935, Mem. Boston Soc. Nat. Hist., 9 (1): 1–166; Hoar, 1939, Journ. Fish Res. Bd. Canada, 4: 441–460). If some of the fish in Lake Jesse would not have migrated until three years of age, then the parr growth was more strikingly rapid. The rapid growth of the young salmon in Lake Jesse is in agreement with the statement of Belding (1935, *op. cit.*: 159) that "almost invariably the lake-fed rivers have more rapidly growing parr than the rivers without lakes." The moderately high temperature level of the unstratified waters of Lake Jesse doubtless had an important influence on the parr growth.

The results from Lake Jesse suggest the possibility of using lakes as rearing areas to secure rapidly growing salmon parr. There was evidence, however, that post-smolt growth was slower in the lake than in the sea, and this is substantiated by Menzies (1912, Fish. Scotland, Salmon Fish. 1911.1: 1–7) who recorded that Atlantic salmon, retained in fresh water in Scotland during post-smolt life, made much poorer growth than if they had normally migrated to sea, although the fish matured and spawned. Similarly, the adult size of the landlocked form of Atlantic salmon in American lakes is decidedly smaller than that attained by the sea-run variety.

Permission from the Fish Culture Branch of the Department of Fisheries of Canada, Ottawa, (Mr. J. A. Rodd, Director) to use the creel census data for for Lake Jesse is gratefully acknowledged.—M. W. Smith, *Fisheries Research Board of Canada, Atlantic Biological Station, St. Andrews, New Brunswick.*

1 Published with permission of the Fisheries Research Board of Canada.

TWO NEGLECTED NAMES FOR A SEA-RUN RACE OF THE BROOK TROUT OF EASTERN NORTH AMERICA.—In his book on "Fishing in American Waters" (New York, 1869) Genio C. Scott used two scientific names which have not received mention in Jordan and Evermann's "Fishes of North and Middle America" (1896), nor in Kendall's treatises on the "New England Fauna" (8, List of the Pisces, 1908) and on "The Fishes of New England" (The Salmon Family, Parts I and II, 1914 and 1935), nor in any other publications which I have seen. These names were employed only on the legend of a figure, but in the same way as recognized names were employed. They are merely Latinizations of the vernacular names. They apply to a fish which in the text is specifically identified as *Salmo fontinalis*. Despite these facts the names, according to current nomenclatorial rules and practices, are potentially available, and therefore demand attention.

The names were presented on page 256, as "THE SILVER OR SEA TROUT.—*Trutta Argentina* or *Trutta marina*." They definitely apply to the sea-run phase of the brook trout, *Salvelinus fontinalis* (Mitchill). The description is decisive. As to its range, Scott stated that "this fish inhabits for nearly half the year the tidal waters of the streams in Canada, Nova Scotia, and Newfoundland. It is also taken in the estuaries of rivers in Maine, Massachusetts, and Long Island." The only locality specially mentioned is "the mouth of the St. John," and this I designate as the type locality of *Trutta Argentina* Scott, 1869, and of *Trutta marina* Scott, 1869.

Specifically both of these names are to be regarded as synonymous with *Salvelinus fontinalis* (Mitchill). When that species is broken up into subspecies, however, one of the names may be considered as applicable to whatever subspecies is recognized as native to the mouth of the St. John River, New Brunswick. According to the interpretations of the rules, *Trutta Argentina* may or may not be regarded as preoccupied by *Salmo argentinus* Linnaeus, 1766. To help remove this difficulty I designate *T. Argentina* Scott as a synonym of *T. marina* Scott, and thereby make sure that the name *argentina* is not available. The name *Trutta marina* was used earlier, but so far as I see only in pre-Linnaean form, as by Duhamel (1769). Scott's use of *Trutta marina* antedates that of Moreau (1881) for the sea trout of Europe (*Salmo trutta*).

Pending a racial analysis of *Salvelinus fontinalis* I would very provisionally regard *Trutta marina* Scott, and with it *Trutta Argentina*, as synonyms of *Salvelinus fontinalis hudsonicus* (Suckley). The status of that form was briefly treated in 1926 (Hubbs, Misc. Publ. Mus. Zool., Univ. Mich., 15: 17–18). It is with regret that I have nothing tc add to that brief and inconclusive discussion.

The name *Salmo albus*, used by Scott for "the white trout"—obviously the salmon—of Schoodic and Grand lakes in Maine, may be regarded as taken from *Salmo albus* Walbaum, which is regarded as a synonym of *Salmo trutta*. Otherwise, *Salmo albus* Scott would be a homonym.—CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

TWO RARE EAST INDIAN CARP.—*Hampala lopezi* Herre: 6 examples, from 56 to 192 mm. in length, were seined from Wayan Creek, Busuanga, Philippine Islands. Many larger specimens readily escaped. Previously known from 3 juvenile specimens 55 to 85 mm. in length, also from Busuanga. These last specimens prove it to be well separated from *Hampala macrolepidota* which is widespread in Borneo, Sumatra, and Malaya. *H. lopezi* reaches a length of two-thirds of a meter or more, and becomes very bulky. Such large fish live in deep holes in the larger streams and according to the local people can only be taken with hook and line. This is one of the large-mouthed predaceous carps.

Puntius huguenini (Bleeker): A good specimen 194 mm. long was bought in the market at Kuala Kangsar, Perak, Malay Peninsula. It is apparently well known to Perak River fishermen, and is regarded locally as a good food fish. Hitherto known only from Bleeker's two examples from Sumatra, one of 176 mm., the other 460 mm. in length.—ALBERT W. C. T. HERRE, *Natural History Museum, Stanford University, California.*

ON NESTING OF THE WHITE CRAPPIE, *POMOXIS ANNULARIS*.—White crappies in the act of guarding eggs were found for the only time in the writer's experience on May 26, 1941, while carrying on a fish survey of Lake Springfield, at Springfield, Illinois. The breeding of this species under outdoor conditions has not been described in the literature, although there are several short accounts of the nesting of the related black crappie, *Pomoxis nigro-maculatus*, and of the nesting of crappie (species?) at the Washington Aquarium. A summary of the literature dealing with crappie nesting is presented by C. M. Breder, Jr. (1936, Zoologica, 21: 1–48).

The nesting white crappies seen at Lake Springfield, unlike the more commonly observed sunfishes, usually seen in open water, were all stationed under or near an overhanging sod ledge where wave action had undercut a clay bank about 12 inches.

The nest site was located on the east side of a shallow bay (75 feet long by 15 feet wide, and only a foot and a half deep in the middle), which lies 100 feet west of the club house at the Lake Press Club. This little bay branches off from a larger one and is fairly well protected from waves generated on the main part of the lake.

The nests were 2 to 4 feet apart. The bank at this point was low and the undercut space was about 10 inches high. The bottom was hard clay and free from silt deposits. The water under the ledge varied from 4 inches to about 8 inches in depth and was clear. Six nesting white crappies were found along this bank, all of them fairly well concealed. Three were back under the ledge so far that only their snouts were visible to a person standing on the bank. The other three were a little in front of the edge of the bank but they were all well hidden from above by a low growing elm sapling. There was no indication of an excavated nest nor was there any need for one since the eggs, instead of being deposited on the bottom, were sticking to surrounding vegetation.

As long as I remained on the bank, I could examine the nesting fish at a range of 12 to 24 inches without their leaving the nests, but, when I waded toward them from the opposite bank they left the nests when I was still 6 feet away.

A search for eggs resulted in finding eggs near two of the six fish. In one instance, eggs numbering only a few hundred were found sticking to dead grass hanging in the water from the edge of the sod shelf and to grass roots hanging from the under side of the shelf. In the other instance, the eggs, numbering at least a thousand, were scattered over a 3-inch ball of elm tree root fibers. No other sort of vegetation was close by to which eggs might have been attached. Both lots of eggs were well off the bottom. Most of the eggs attached to the grass were within an inch of the surface of the water.

The behavior of the four fish near which no eggs were seen was the same as that of the other two and if they were not guarding eggs they were apparently guarding nesting territory. All were headed toward open water, and kept up a fanning motion of the pectoral fins. One of the fish, which did not seem to be guarding eggs, was identified by his darker pigmentation as a male. The sex of the others could not be ascertained because of poorer light conditions. All the fish were estimated at between 6 and 7 inches in length. Scale collections made in May, 1941, show the Lake Springfield white crappie population to be stunted. Judging from the ages of white crappies of similar size caught in hoopnets at this time, these specimens must have been three or four summers old.

A few eggs were collected and incubated in an aquarium, but they did not hatch. The ball of elm roots with attached eggs was preserved in weak formalin. The eggs were small and of markedly uniform size, averaging 0.89 mm. These white crappie eggs were much smaller than the eggs of either the largemouth or smallmouth black bass measured by J. E. Reighard (1905, 16th Bien. Rept. Mich. State Board Fish Comm., Appendix 1–73).

The above observations were made with the assistance of L. J. Hoggatt. Mr. Hoggatt and Mr. L. C. Peyton, both of Springfield, kindly watched for spawners at the same undercut bank site in May and June, 1942, but saw none. Probably another authentic case of white crappie nesting was observed by Mr. Hoggatt and other members of the Lake Press Club when a crappie nest was found under the club boathouse in June, 1940. Mr. Hoggatt gave a few details of this nest in a letter dated February 7, 1943. The guarding fish was about 7 inches long and had fanned out a shallow nest 5 or 6 inches across—exposing sand at the bottom. The guarding fish was stationed over the center of the nest and was not frightened by spectators unless they dipped their hands in the water. The probability that this fish was a white crappie rather than a black

crappie is shown by 1941 hoopnet samples. Hoopnetting operations, which lasted 2 weeks, resulted in the capture of 2,100 white crappies but no black crappies.

Many people who have observed the nesting of bluegills and largemouth bass in Illinois have never seen the nesting of crappies. This is quite apparent from talks with both net fishermen and sportsmen. Since the crappies are among the most abundant centrarchids in Illinois the places which the crappies choose for spawning must, as a rule, be different from the places chosen by the other members of the family. The nests of the black crappie described in the literature were either in deep water or in the shade provided by weeds or by undercut banks. The white crappie nests found at Lake Springfield, it will be noted, were also shaded; that is, by overhanging trees, undercut banks, and one by a boathouse. The scarcity of observations on crappies suggests that perhaps these fish most often nest in deeper water than that in which the nests have usually been found, where increased distance from the bank and lowered visibility would limit the number of observations. But, irrespective of the depth of water over the nests, the crappie habits observed by one or more investigators, (1) of nesting more or less apart from one another, (2) of sometimes failing to excavate a nest, (3) of nesting among water weeds (observed only in the black crappie), and (4) of nesting under objects, are all factors which would tend to conceal location of the spawners.

At the present writing, descriptions of nest building and of mating remain to be made for both species.—DONALD F. HANSEN, *Illinois Natural History Survey, Urbana, Illinois.*

TERMINOLOGY OF EARLY STAGES OF FISHES.—For years, as teacher and editor, I have tried to establish in America the more precise European terminology, in which the pre-juvenile stages of fishes are known as "larva" from the stage of hatching to the time when the yolk is absorbed, and thence as "postlarva" until the young stage transforms into the juvenile. My efforts have met with no great success: the term larva is still commonly appled to the entire period of well-differentiated, post-embryonic development. This broader application of "larva" to fishes corresponds with the general use of the word in biology. That we should so employ the term in ichthyology is indicated not only by logic but also, which is more important, by continued general usage. When a more precise classification and terminology is called for, it would obviously be better to subdivide the larval stages into prolarval and postlarval, thus avoiding the double sense—general and precise—now attributed to "larval."

There is also a need for the precise terminology of other stages in the early development of fishes. I recommend the following denotations:

Embryo.—Developmental stages to the moment of hatching or of birth.

Larva.—Developmental stages well differentiated from the juvenile and intervening between the times of hatching and of transformation; commonly divisible into prolarva and postlarva.

Prolarva.—Larva still bearing yolk.

Postlarva.—Larva following the time of absorption of yolk; applied only when the structure and form continues to be strikingly unlike that of the juvenile.

Alevin.—Larva of species in which postlarval stages are not recognized; that is, in which the yolk-bearing larva transforms directly into the juvenile (example: Salmonidae).

Juvenile.—Young essentially similar to adult.

Young and *half-grown.*—Terms to be loosely applied, because any precise distinction involves age determination, after which the following terminology of the life-history workers becomes applicable. In their practice the *age-groups* (a generally used and precise term, therefore to be hyphenated) are numbered 0, I, II, etc. There is discrepancy as to the time when one group changes into the next one. For reasons that I think will be obvious I favor a division at the date of January 1 (or of July 1 in the Southern Hemisphere; let the workers in the Tropics worry).

Young-of-year.—Member of age-group 0, from transformation into juvenile until January 1 (or July 1).

Yearling.—Member of age-group I, in second calendar year.

Two-year-old.—Member of age-group II, etc.

There would clearly be many advantages in the adoption of a uniform terminology of young fish stages.—CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

Reviews and Comments

MOST of the great fisheries of the world are international in scope. The fish populations involved are distributed along the coasts of several nations; or they migrate from the waters of one country to those of another; or they may spread beyond the artificial boundaries of marginal seas into international territory. In our own part of the globe are examples aplenty, of which the tunas, the Pacific sardine, the halibut, the mackerels of both coasts, and the North Atlantic groundfishes are among the most important. In the Eastern Hemisphere the situation is far more complicated than in the Western, what with the multiplicity and proximity of maritime nations. It is an intricate mass of problems as to how the various countries are to divide the exploitation of their communal resources; or what is growing more important, as to how they are to perpetuate their fisheries on a profitable level by management practices. Such problems have rarely been faced with full honesty by all interested parties. It has been common experience for one or more nations to nullify the proposed effect of international marine agreements by failing to ratify, or by claiming exemptions for various special occasions. At the end of this war, the peacemakers must face the problems involved in the "ownership," exploitation and conservation of the world's fishery resources, and they must attempt to solve these problems unselfishly, in the interests of maintaining an orderly and peaceful world. It is in recognition of this fact that the following two books have been written:

PROTECTION OF COASTAL FISHERIES UNDER INTERNATIONAL LAW. By Stefan Riesenfeld. Carnegie Endowment for International Peace, Division of International Law, Monograph No. 5, 1942: XII + 282.—This gives the history of international maritime law, with respect to the fisheries, and reviews present practices of all the maritime nations. The author foresees no simple solution of the problems discussed above. He says, "... the answer ... can be found only in the application of international law as a means of adjustment of the various national interests in the spirit of a community of nations.... If, after the present war, an international society and an international legal order should be resurrected, though probably in different form, the continual controversies which the coastal fishing grounds have caused under the old system should be studied to determine what should be done and what avoided in the future."

INTERNATIONAL AGREEMENTS ON CONSERVATION OF MARINE RESOURCES. By Jozo Tomasevich. Food Research Institute, Stanford University, 1943: XI + 290. $3.00.—This is a scholarly and realistic review of the aims and problems of fisheries research, with particular reference to three fisheries of international scope, whose conservation has involved international collaboration, namely the Pacific fur seal, the Pacific halibut and the Fraser River sockeye salmon. These are relatively simple cases, to be sure, but they serve very well as examples for a peaceful and fruitful treatment of intergovernmental problems.—L. A. Walford, *Stanford University, California.*

THE OCEANS, THEIR PHYSICS, CHEMISTRY, AND GENERAL BIOLOGY. By H. U. Iverdrup, Martin W. Johnson and Richard H. Fleming. x + 1060, 265 figs., 7 charts, tables, $8.00.—At last we have in the English language a new text and reference work in Oceanography. Knowledge in this field has grown vastly since Murray and Hjort's "Depths of the Ocean" was written, and it is high time a comparable work appeared for our day. The book covers, in an authoritative and comprehensive way, the chemistry, physics, biology, geography and geology of the sea, and shows beautifully the interrelations among these sciences. A generous presentation of formulae, tables and charts gives the book a reference value to the worker not equipped with encyclopedic knowledge in the above mentioned subjects; and good bibliographies follow each chapter. Finally, the authors are to be complimented on presenting intricate and technical subject matter in a clear, understandable and simple way.—L. A. Walford, *Stanford University, California.*

JOSEPH GRINNELL'S PHILOSOPHY OF NATURE. Selected Writings of a Western Naturalist. University of California Press, Berkeley and Los Angeles, 1943: i-xv, 1–237, illus. incl. 2 color plates. $2.00.—Natural History has been rather unfashionable among American biologists during recent years. At least the mode of activity has centered around fundamental causes—the vital processes, the physico-chemical aspects of Life. This has tended to drive those few souls who persist in studying the biology of entire organisms into dark corners to mutter defensively among themselves against the new-fangled Biologists; and the latter reply disdainfully by sharpening their focus on The Cell. This vicious circle thus set up has had the bad effect of splitting Biology into two great parts, neither of which can ever be complete without the other.

Nevertheless, the breach between the two widens with time and young men are growing up in one "field" with little if any knowledge of the other or interest in it. In the face of this growing specialization, Joseph Grinnell's work is a stimulus to widen one's view and become conscious of the homely but inexpressibly complex world of whole organisms.

Grinnell was a whole biologist. He was not a mere collector of specimens and namer of species; nor was he a mere virtuoso in recognizing organisms in the field. He was a keen observer of Nature *in situ*, and he interpreted what he observed in terms of populations living together and in terms of their relations with the physical world.

"Joseph Grinnell's Philosophy of Nature" is a collection of his published papers, made after his death and bound in book form to commemorate the Seventy-Fifth Anniversary of the founding of the University of California. It is a well chosen collection. Even though this is not the book that Grinnell had planned, these papers speak for themselves the philosophy he had hoped one day to set down.—L. A. WALFORD, *Stanford University, California.*

EVOLUTION THE MODERN SYNTHESIS. By Julian Huxley. Harper and Bros., New York, 1942: 645 pp. $5.00.—A number of new books have been flying straws indicating a change in the direction of scholarly interest in biological thought. There has been a generation of extreme fragmentation of the biological disciplines as separate sciences, sometimes in such thought-tight compartments that the practitioners engaged in the game of contemptuous attitudes and even of published expression of contempt for some of the older fields of enquiry. More recently voices have been raised and books written to point out the interdependence of the several sciences, and especially the values offered by systematic botany and zoology to genetic and other experimental enquiries; and, quite justly, to emphasize the important contributions of these newer fields to systematics and morphology.

Julian Huxley's new book on evolution results from the impact of modern genetics on evolutionary thought. At the turn of the century the nature of variation and of inheritance were so little understood that critical thinkers inclined to doubt the rôle of natural selection in evolution. The first enthusiasm over the re-discovery of the Mendelian principles of inheritance, with its emphasis on conspicuous mutation also seemed to cast doubt upon the essentially Darwinian contribution to evolutionary causation. Modern genetics, with its innumerable small mutations, its concept of mutation pressure, and its analysis of selection—value, seems to be a return to an essentially Darwinian pattern of thoughts. It is the very modern interest of geneticists in the problem of the origin of species, in field zoology and observation of environments, and in the problem of adaptation, that is summarized in Huxley's work. It is appropriate that the grandson of T. H. Huxley, the popularizer and defender of Darwin, should present a review of the modern state of evolutionary thought, the more so in that modern views exhibit so notable a return to Darwinian principles.

The first four chapters review the principles of genetics as they impinge on evolution. The remaining chapter heads are: 5. The Species Problem; Geographical Speciation; 6. Speciation, Ecological and Genetic; 7. Speciation, Evolution, and Taxonomy; 8. Adaptation and Selection; 9. Evolutionary Trends; 10. Evolutionary Progress. These chapters are of vital importance to the modern systematic zoologist and botanist, who may find himself compelled at once to acquire the knowledge of genetics and of statistical analysis that will be the equipment of every taxonomist of the future. So equipped, he will be welcomed by the experimentalist.

The modern naturalist will indeed be a pied piper, with all sorts of strange creatures following him into the laboratory. The naturalist, in his turn, will profit by the exactness of method and the critical attitude of his laboratory colleagues, when they can be induced to join him in the field.—KARL P. SCHMIDT, *Field Museum of Natural History, Chicago, Illinois.*

ON YOUR OWN: HOW TO TAKE CARE OF YOURSELF IN WILD COUNTRY. A MANUAL FOR FIELD AND SERVICE MEN. By Samuel A. Graham and Earl C. O'Roke. University of Minnesota Press, Minneapolis, 1943: 10–150, 50 figs. $2.00.—That the well known authority on forest insects, S. A. Graham, should be the senior author of an excellent little book on woodcraft is no surprise to the reviewer, who remembers him as a colleague in giving a fairly strenuous introduction to natural history to Cornell freshman a generation ago.

The problems of the man lost in the woods, in the desert, or at sea have had attention focussed upon them by numerous actual cases, especially of aviators, and have received deserved attention from the various armed services. How to secure water at sea, how to find edible plants in the tropical forest, how to avoid poisonous plants and animals, and the special problems of the tropical coral islet or of the Arctic tundra have been largely solved by drawing upon specialists of all kinds and by active experiment. The apparently successful shark-repellant now becoming available will certainly remove a hazard both real and psychological to the cast-away.

The fourteen sections of the book are crammed with advice that will be useful to the tenderfoot, and most of us are 'tenderfeet' under new conditions and in a new part of the world.

As the authors remark, this booklet is not directed to the more experienced woodsman. Both Graham and O'Roke have had first hand experience in a great variety of conditions in this country; the discussion of insect pests and repellants seems especially useful. So does the advice with regard to natural food supplies. The additions to the text in the attempt to extend the usefulness of the book to exotic conditions are not always so well considered. The dangerous eels of coral reefs, for example, are morays rather than the conger. While the section on snake bite and the treatment of snake-bite is excellent, it perhaps tends to overemphasize this danger. It would be well to point out that the clearing of air fields in the tropics is likely to disclose poisonous snakes in some numbers. The first report of the presence of snakes in New Zealand should have been offered to COPEIA before letting it appear in a book.—KARL P. SCHMIDT, *Field Museum of Natural History, Chicago, Illinois.*

BIOLOGY THE SCIENCE OF LIFE. By Mary Stuart MacDougall, in collaboration with Robert Hegner. McGraw-Hill Book Co., New York, 1943: x+963, 555 figs., $4.00.—An elementary but comprehensive work on general biology made attractive by interesting and simple illustration, and brought into the orbit of interest of the beginner by its emphasis on human relations and on the biology of man, is offered by the McGraw-Hill Company in the MacDougall-Hegner volume. Such a work is something more than a text—it might well remain on the family shelves for casual discovery by inquiring young members of the family after its school use. The reviewer, at any rate, would have been attracted to it, after his introduction to zoology through Hornaday and Lydekker, and would have been prepared by such a work for his premature first attempt to read *The Origin of Species.*

Excellent as this work is in general plan, and in illustration, the reviewer's editorial fingers itch to blue-pencil it in detail. There is still too much emphasis on the Latin names of animals—*Birds* should be the chapter and running head, not Aves, so the reader might learn the term Aves only as he needs it. "Amphibia," the Cambridge Natural History notwithstanding, is not the correlative of "reptiles." The grand evolutionary perspective of the alternation of generations in plants, and Hoffmeister's importance in the history of botany, do not appear. The chapter on history is too short to be more than a catalogue of names. The language is occasionally inept, failing to make the distinction between the relative pronouns 'which' and 'that', using 'rudimentary' where vestigial is meant, and occasionally with no clear antecedent for a pronoun. 'Fish' is not distinguished from 'fishes.'

The special chapters in all general works should go through the hands of specialists, and it might be best not to depend on the author's friends but have such circulation done by the publishers. The present work is marred in the chapters on amphibians and reptiles by needless errors, such as 'offensive,' as applied to the plainly *defensive* poison glands of toads, the omission of crocodiles in the opening paragraph on reptiles, the use of *Crocodilia* as a generic name, of regal python for reticulated python, the execrable Ditmarsian definition of 'tortoise,' 'terrapin,' and 'turtle,' and by a very inadequate list of references. Any mammalogist would have added the readily available general work by Hamilton, and Seton's invaluable *Lives of Game Animals,* to the references in Chapter 33.

These errors and omissions are mostly minor and in matters of detail; they are the more exasperating for unnecessarily marring an otherwise excellent work.—KARL P. SCHMIDT, *Field Museum of Natural History, Chicago, Illinois.*

NEW BOOKS RECEIVED

FRONTIERS IN CYTOCHEMISTRY; THE PHYSICAL AND CHEMICAL ORGANIZATION OF THE CYTOPLASM. Edited by Normand L. Hoerr. Jaques Cattell Press, 1943: VII + 334. $3.50.—A collection of 15 papers on the biochemistry of cytoplasm, published in honor of Professor R. R. Bansley.

HANDBOOK OF SALAMANDERS: Sherman C. Bishop. Comstock Publ. Co., 1943: XIV + 555, 1 col. pl., 143 figs., 56 maps. $5.00.—Review to follow.

EDITORIAL NOTES AND NEWS

Walker Prize

THE WALKER PRIZE IN NATURAL HISTORY, offered annually by the BOSTON SOCIETY OF NATURAL HISTORY for the two most acceptable papers written in the English language, on a subject chosen by the Board of Trustees of that Society, is to be awarded in 1944 for the best papers in the field of reptiles. The first choice of the judges may receive a prize of $60, which may be increased to $100 for a paper of exceptional merit. A second prize of $50 may be awarded if the second choice of the judges seems worthy of the distinction.

Each paper must be the result of original and unpublished research personally conducted by the author and accompanied by an accurate bibliography and a review of the general literature on the subject. All papers must be typewritten and in complete form for publication. Each paper must be anonymous, with only a pseudonym in a conspicuous place on the front page, and accompanied by an envelope bearing this pseudonym on the outside and the name and address of the author sealed within. If anything in the paper furnishes proof of the identity of the author, it shall be barred from the competition.

All competitors must submit their work to the Secretary, Boston Society of Natural History, 234 Berkeley St., Boston 16, Massachusetts, before May 1, 1944. The Society assumes no responsibility for the publication of the winning papers and it is understood that authors should not publish their papers until after the announcement of the prize awards at the Annual Meeting of the Society in October, 1944.—CHARLES H. BLAKE, *Secretary.*

John O. Snyder

THE death of JOHN OTTERBEIN SNYDER, at Palo Alto, California, on August 19, takes from us one more of the able ichthyologists who, gathered about David Starr Jordan, made Stanford University the ichthyological capital of America. Snyder's outstanding contributions to ichthyology, partly in collaboration with Jordan and all resulting in large degree from Snyder's own

JOHN OTTERBEIN SNYDER, 1867–1943 [1]

extensive field explorations and care-taking systematic analyses, deal with various groups of fishes in Japan, and with the Japanese fish fauna in general; less extensively with the fishes of Hawaii and other Pacific islands; also with the fresh water fishes of Mexico and of the Pacific drainages and the Great Basin of the United States; most recently with the life history and conservation of salmon. His most intense interest lay in the "origin

[1] Portrait by Carleton W. Angell, Sculptor, University Museums, University of Michigan.

and relationships of the fish faunas of the rivers and lakes of western North America," and in this field of study his contributions were particularly impressive.

After spending his freshman year at Indiana University Snyder followed Jordan to Stanford, where, with minor interruptions, he served through the ranks until 1932. He then retired as head of the zoology department but for five more years actively continued his fish work as chief of the Bureau of Fish Conservation of the California Division of Fish and Game. In this last position he rendered an outstanding service to the state. Carrying his share of public service, however, was not a new adventure. Kindly counsel, genial companionship, inspiration for outdoor life and the study of nature, able teaching, top-ranking citizenship, were gifts that Snyder continually bestowed on his students and associates. He did his full part, effectively but always with becoming modesty and unselfishness, in helping to make the world a better place to live in.—CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

News Notes

PROF. WILLIS RICH, on leave from Stanford University, is in war service with the U.S. Fish and Wildlife Service. For some months he has been acting as administrator of fishery production in the Office of the Coordinator of Fisheries at San Francisco. He has recently been transferred to Seattle, in charge of North Pacific Fishery Investigations. He was succeeded in San Francisco by VERNON E. BROCK, on leave from the Department of Research of the Fish Commission of Oregon for the duration.

The officers of the WESTERN DIVISION of the Society have decided not to hold a meeting in the spring of 1944. This decision results from the fact that 76 per cent of the members have voted not to hold meetings during the war.

CORP. D. DWIGHT DAVIS has been transferred to the A.S.T.U. He is engaged in a nine-months course in Russian at the University of California at Berkeley.

DR. WILLIAM K. GREGORY has been honored by Columbia University by his appointment as Da Costa professor of vertebrate paleontology.

T. P. HAINES, formerly on the staff of the Zoology Department, University of Michigan, has been appointed instructor in the Biology Department of Mercer University, Macon, Georgia.

Additions to and changes in the honor roll of Society members in the United States armed forces are: RICHARD EDGREN, JR., U. S. Army; WALTER NECKER, U. S. Navy; WM. STICKEL, U. S. Army; W. T. STILLE, JR., A.S.T.P., U. S. Army.

DR. L. R. RICHARDSON of Victoria University College, Wellington, W. L., New Zealand, sends the following news items: K. R. ALLEN, formerly Biologist with the Freshwater Biological Association of the British Empire stationed at Lake Windermere, and recently Fisheries Biologist with the Marine Department, Wellington, is now serving on instructional duties in the Technical Branch of the New Zealand Ordnance Corps. Mr. Allen had been primarily concerned in New Zealand with studies on fundamental problems in the feeding of salmon and brown trout. D. CAIRNS, formerly Fisheries Biologist to the Marine Department, New Zealand, and now attached to the Plant Research Bureau, Department of Scientific and Industrial Research, Wellington, has recently completed publication of his detailed studies in the life histories of the two species of New Zealand freshwater eel (N. Z. Journ. Sci., 23). A. M. RAPSON, Marine Biologist, Department of Marine, is at present undertaking studies on the life history of the New Zealand pilchard (*Sardinops neopilchardus*), and the New Zealand sprats (*Clupea antipodum* and *C. mulleri*). D. F. HOBBS, formerly Freshwater Biologist, Marine Department, New Zealand, is now serving with the Royal New Zealand Navy.

Aid in printing the plates in this issue has been received from the SPECIAL GIFT FUND of the Society.

Errata

IN COPEIA (1), 1943, in "On a Collection of Reptiles from Palestine, Transjordan, and Sinai," by Georg Haas, the following changes should be made: p. 10, line 16, for El Kuntiala read El Kuntilla; p. 11, line 40, for Ain Teshka read Ain Feshkha, and for Wadi Ohar read Wadi Ghar; p. 12, line 23, for Gazal read Gaza; p. 13, line 23, for Anja read Auja.

INDEX TO SCIENTIFIC NAMES
1943, NOS. 1-4

New names and their principal references are printed in bold face type.

acanthi, Rana, 149
acanthias, Squalus, 188–89
Acanthodactylus, 13
  boskianus asper, 13
  grandis, 13
  pardalis pardalis, 13
  robustus, 14
  schreiberi syriacus, 13
  scutellatus, 13
    scutellatus, 13
  tristrami, 12
Acanthurus triostegus, 130
Archeilognathus cyanostigma, 183–86
  tabira, 183–84, 186
Acipenser sturio oxyrhynchus, 86
Acris crepitans, 59
adspersa, Emoia, 59
advena, Nuphar, 25
Agama mutabilis sinaita, 11
  ruderata, 12
    pallida, 10, 12
    ruderata, 12
  stellio, 12
    stellio, 12
Agkistrodon, 142
  mokeson cupreus, 250
  piscivorus, 59
Agosia chrysogaster, 253
albofrenata, Hyla, 226
albosignata, Hyla, 226
albus, Salmo, 258
Alectis, 207
algirus, Periops, 144
Allenrolfea occidentalis, 75
Alligator, 142
  mississippiensis, 59
Alopias, 54–55
  pelagicus, 55
  profundus, 55
  vulpinus, 55
Alosa sapidissima, 86
Alsophis angulifer, 110
alticola, Eleutherodactylus, 238, 241
alvarius, Bufo, 128
Alytes, 148
amabilis, Diadophis, 145
  Diadophis amabilis, 146
  Sericomyrmex, 121
amaurus, Notropis hudsonius, 86–87
  Rhodeus, 183–85
Ambloplites rupestris, 132
    rupestris, 86, 162
Ambystoma, **subsalsum, 152,** 153
Ameiurus, 39
  melas melas, 35, 39, 86, 162–63
  natalis natalis, 35, 39, 163
  nebulosus, 34
    natalis, 86
    nebulosus, 86–88, 162
americana, Morone, 86, 88
americanus, Bufo, 248–49
  Esox, 86–87
  Pseudopleuronectes, 254
Amia calva, 92, 162
Amiurus catus, 34
Amyda spinifera spinifera, 21
Anabasis, 10
analis, Lutianus, 214
andersonii, Hyla, 246–48
andreae, Dromicus, 194
Anguilla bostoniensis, 86
angulifer, Alsophis, 110
Aniella, 4–6
  nigra, 2
  pulchra, 2
    nigra, 2–6
    pulchra, 2–6, 146
anisurum, Moxostoma, 35, 38, 162
annectens, Pituophis catenifer, 109
annularis, Pomoxis, 162, 259
anogenus, Notropis, 162
Anolis carolinensis, 59, 196
  nebulosus, 250
anomalus, Thalassophis, 156–59
Anopheles quadrimaculatus, 126
Anoptichthys jordani, 26–28, 82
  ruberrimus, 83
anthonyi, Masticophis, 143
Anthurium, 119
antiquorum, Pristis, 43, 46
Apocope, 188
Apogon chrysopomus, 217
  fusca, 217
  hypselonotus, 217
  kiensis, 217
  leptacanthus, 217
  melas, 217
Apogonichthys glaga, 218
  poecilopterus, 218
  striatus, 218
Apostolepis, 129
aprinus, Cirrhitichthys, 130
Aprodon, 186
  cortezianus, 186
Argentina, Trutta, 258
argentinus, Salmo, 258
Arizona, 58, 196
  elegans, 145
    occidentalis, 145, 147, 196
Artemia, 220
Ascaphus, 126–27, 140, 148
  truei, 125–27
asianus, Zamenis jugularis, 143
asper, Acanthodactylus boskianus, 13
Astyanax, 28, 83–84
  mexicanus, 26, 28, 82, 84

atherinoides, Notropis atherinoides, 162
atratulus, Rhinichthys atratulus, 86–88
atricaudatus, Crotalus horridus, 250
atriceps, Hydrophis fasciatus, 156
Atriplex linearis, 75
atromaculatus, Semotilus atromaculatus, 86–88, 163
Atta, 121
  colombica, 121
Aulophallus, 219
auratus, Carassius, 86
  Notemigonus crysoleucas, 35-36, 38, 163
aurea, Hyla, 122
aureolum, Moxostoma, 35, 38, 162
aurigulus, Masticophis, 143
auritus, Lepomis, 86–87
aurorubens, Rhomboplites, 214
australis, Engyrus, 59
  Masticophis taeniatus, 143
aya, Lutianus, 213
Azteca, 121

bairdii, Cottus, 42
  Cottus bairdii, 162
barbouri, Masticophis, 143
Barbourula, 148–50
  busuangensis, 148
Bascanion, 142
Basiliscus basiliscus, 118–19
basiliscus, Basiliscus, 118–19
  Crotalus, 109
Belone, 182
bernardini, Catostomus, 253
bicarinata, Uta, 99–100
bifrenatus, Notropis, 86–88
biguttatus, Nocomis, 163
bilineatus, Masticophis, 143
binghami, Trachurus picturatus, 205
blackfordii, Lutianus, 213
blandingii, Emys, 196
Boleosoma nigrum eulepis, 163
    nigrum, 163
    olmstedi, 86–87
Bombina, 148, 150
  bombina, 150
  maxima, 150
  orientalis, 150
  variegata, 150
bombina, Bombina, 150
bombonensis, Mionurus, 217
bondi, Cyprinodon, 70
Borborocoetes, 230
boreas, Bufo boreas, 251
bostoniensis, Anguilla, 86
bottae, Charina, 128–29, 147
  Thomomys bottae, 194
boulengeri, Pleurogobius, 132
  Pterogobius, 132
bovinus, Cyprinodon, 70
brama, Cyprinus, 34
boylii, Rana boylii, 56, 126
Brachygnathosuchus, 123–24
  brasiliensis, 123–24
brasiliensis, Brachygnathosuchus, 123–24
  Purussaurus, 123–24
brevirostris, Eremias, 10, 14
brevis, Fundulus parvipinnus, 52
  Xiphophorus helleri, 32
Brevoortia, 53
brookii, Hydrophis, 156–59
brunnea, Hyla septentrionalis, 234
bubalus, Ictiobus, 35, 37–38
Bufo alvarius, 128
  americanus, 248–49
  boreas boreas, 251
  canorus, 197
  marinus, 234
  terrestris, 193
  valliceps, 59
busuangensis, Barbourula, 148

caeruleus, Poecilichthys caeruleus, 163
Caiman, 123–24
Calamaria, 129
Calathea cylindrica, 225
californiae, Lampropeltis getulus, 147
calva, Amia, 92, 162
campechanus, Lutianus, 213
Camponotus, 121
Campostoma anomalus pullum, 163
canorus, Bufo, 197
caprodes, Percina caprodes, 162
Caranx, 205, 209
Carassius auratus, 86
carbonarius, Zamenis viridiflavus, 143
Carcharhinus cerdale, 189
carinatum, Xenogramma, 50
carminatus, Enneaptergius, 130–31
carolina, Terrapene, 112, 196
carolinensis, Anolis, 59, 196
  Gastrophryne, 59
carpio, Carpiodes, 35, 54
  Carpiodes carpio, 38
  Cyprinus, 34–36, 38, 54, 86, 162
Carpiodes, 38, 54
  carpio, 35, 54
    carpio, 38
  cyprinus, 35, 38, 162
  velifer, 35, 38
caspius, Zamenis jugularis, 143
casus, Stephanocasmus, 212
cataractae, Rhinichthys, 86–88
catenifer, Pituophis catenifer, 145, 147
catesbeiana, Rana, 19, 59, 122
Catonotus flabellaris lineolatus, 163
Catostomus bernardini, 255
  catostomus catostomus, 86, 88
    nannomyzon, 86–88
  commersonnii commersonnii, 35–36, 38, 48, 86–88, 163, 256
catostomus, Catostomus catostomus, 86, 88
catus, Amiurus, 34
Causus rhombeatus, 114
centralis, Gyretes, 121
Cephalotes, 121
cerastes, Crotalus, 58, 115, 117, 128
Ceratophrys, 226, 230
Ceratophyllum demersum, 75
cerdale, Carcharhinus, 189
Chaenobryttus coronarius, 162
Chalcides ocellatus, 14
Chamaecyparis wilsoniana, 125

Charina, 129
bottae, 128–29, 147
Cheilodipterus subulatus, 217
Chelydra serpentina, 21, 196
serpentina, 59
Chirostoma, 152
Chirodorus, 182
Chrosomus eos, 86, 88
erythrogaster, 162
Chrysemys picta, 196
chrysocephalus, Notropis cornutus, 163
chrysogaster, Agosia, 253
chrysopomus, Apogon, 217
Cichlasoma, 60
Cichlaurus, 60
cinerea, Hyla, 248
Hyla cinerea, 59
cinereous, Crotalus, 115, 117–18
Cingulogobius, 132
Cirrhitichthys aprinus, 130
corallicola, 130
Citellus leucurus, 242
clamitans, Rana, 59
clavata, Paraponera, 121
Clemmys insculpta, 196
muhlenbergii, 197
Cobitis fossilis, 34
cognatus, Cottus, 86–88
Coleonyx variegatus, 196
Cololabis, 181–82
saira, 171, 173, 175–76, 178–79
colombica, Atta, 121
Coluber, 58, 141–42, 144
constrictor, 142
constrictor, 142
flaviventris, 142
mormon, 142
priapus, 142
stejnegerianus, 142
fasciolatus, 144
flagellum frenatus, 147
karelinii, 144
lateralis, 111
spinalis, 142
ventromaculatus, 143
commersonnii, Catostomus commersonnii, 35–36, 38, 48, 86–88, 163, 256
concolor, Crotalus, 251
Crotalus durissus, 251
confluens, Natrix sipedon, 59
constrictor, Coluber, 142
Coluber constrictor, 142
contortrix, Heterodon, 193
corallicola, Cirrhitichthys, 130
cornutus, Notropis cornutus, 86–88
coronarius, Chaenobryttus, 162
coronella, Eirenis coronella, 14
corporalis, Leucosomus, 86–88
cortezianus, Aprodon, 186
Coryphodon, 142
Coryphoterus urospilus, 130
Cosymbotus, 192
platyurus, 192
Cottus bairdii, 42
bairdii, 162
cognatus, 86–88
meridionalis, 42
semiscaber, 41–42
couchianus, Platypoecilus, 219
couchii, Scaphiopus, 128
Couesius plumbeus plumbeus, 86, 88
couperi, Drymarchon corias, 250
Craspedoglossus, 230
bolitoglossus, 230
Crematogaster, 121
crepitans, Acris, 59
Cristivomer namaycush namaycush, 253
Crossodactylus, 230
Crotalus, 111, 250, 251
basiliscus, 109
cerastes, 58, 115, 117, 128
cinereous, 115, 117–18
concolor, 251
durissus concolor, 252
horridus, 251
atricaudatus, 250
horridus, 251
lucasensis, 115, 117
ruber, 108, 111, 115, 117, 242
viridis decolor, 251
nuntius, 115, 117
oreganus, 58, 115, 117–18, 147, 250
viridis, 15, 115, 117–18
crucifer, Hyla, 248
crysoleucas, Notemigonus crysoleucas, 86–88
Cryptocerus, 121
culveri, Trachinotus, 209
cundalli, Eleutherodactylus, 238
cupreus, Agkistrodon mokeson, 250
cyanellus, Lepomis, 163
cyanocephalus, Notropis umbratilus, 162–63
cyanocinctus, Hydrophis, 156–59
cyanostigma, Acheilognathus, 183–86
cyanura, Emoia, 59
cyclopion, Natrix, 59
Natrix cyclopion, 59
Cyclorhamphus, 226, 230
eleutherodactylus, 231
fuliginosus, 230
granulosus, 231
pinderi, 230
Cylindrophis, 129
cyprinella, Megastomatobius, 35, 37–38
Cyprinodon, 69, 72, 74–75, 77
bondi, 70
bovinus, 70
rubrofluviatilis, 70
diabolis, 70, 72–73, 77
laciniatus, 70, 72
macularius, 72–73, 77
nevadensis, 72–73, 77
salinus, 69, 70–75, 77
Cyprinus brama, 34
carpio, 34–36, 38, 54, 86, 162
cyprinus, Carpiodes, 35, 38, 162

dahlii, Zamenis, 143
Daphnia, 220
Decapterus, 209
decolor, Crotalus viridis, 251
decora, Leurodera, 212
dekayi, Storeria, 59, 252

demersum, Ceratophyllum, 75
Dermosteira dorotheae, 133
Derris, 60, 92
Desmognathus, 192
  fuscus fuscus, 192
diabolis, Cyprinodon, 72, 72–73, 77
Diadophis, 146
  amabilis, 145
    amabilis, 146
diaphanus, Fundulus diaphanus, 86–87
Dicamptodon, 125–26
Dinosuchus, 123–24
  neivensis, 123
  terror, 123–24
Dipodomys, 242
dipsas, Herpetodryas, 144
Discoglossus, 148, 231, 233
  nigriventer, 231, 232
  pictus, 231
    pictus, 233
    sardus, 233
dispar, Fundulus dispar, 162
Distichlis spicata, 75
Dolichoderus, 121
Doliophis, 129
dolomieu, Micropterus dolomieu, 86, 163
dorotheae, Dermosteira, 133
dorri, Periops, 144
Doryrhamphus melanopleura, 130
Dromicus, 194–95
  andreae, 194
  nebulatus, 194
Drymarchon, 250
  corias couperi, 250
duquesnii, Moxostoma duquesnii, 162

Ectatomma, 121
  tuberculatum, 121
edentula, Lechradena, 212
Eirenis coronella coronella, 14
Elaphe, 58, 142
  laeta, 110
  quadrivittata quadrivittata, 111
  vulpina vulpina, 250
elegans, Arizona, 145
  Ophiops, 10
  Ophiops elegans, 14
  Stenodactylus, 10
Eleotris pictus, 130
Eleutherodactylus, 225, 234
  alticola, 238, 241
  cundalli, 238
  fuscus, 235
  grabhami, 239
  jamaicensis, 240
  lewisi, 236
  luteolus, 236
  martinicensis, 239–40
  nubicola, 238
  orcutti, 241
  pantoni, 235–38
  ricordii, 239
eleutherodactylus, Cyclorhamphus, 231
Emoia adspersa, 59
  cyanura, 59
  murphyi, 59
  nigra, 59
samoensis, 59
Empetrichthys, 69
Emys blandingii, 196
Encytraeus, 220
Engyrus australis, 59
Enhydrina schistosa, 156–59
Enneacanthus obesus, 86, 88
Enneaptergius carminalis, 130–31
  storeyae, 131
eas, Chrosomus, 86, 88
Eremias brevirostris, 10, 14
  guttulata guttulata, 14
Erimyzon oblongus oblongus, 86–88
erythrogaster, Chrosomus, 162
erythrurum, Moxostoma, 35–36, 38
esculenta, Rana, 19
Esox americanus, 86–87
  lucius, 86, 162
  niger, 86–88
  vermiculatus, 131, 163
Eucalia inconstans, 92, 162
eulepis, Boleosoma nigrum, 163
Eumeces fasciatus, 196
  parvulus, 250
  schneideri pavimentatus, 14
  skiltonianus skiltonianus, 58
Eurycea lucifuga, 126
exilis, Poecilichthys, 162

Fagasa tutuilae, 133
falcatus, Trachinotus, 209
fario, Salmo, 166
  Salmo trutta, 86, 90
fasciatus, Eumeces, 196
  Hydrophis, 157–59
fasciolatus, Coluber, 144
flagellum, Masticophis flagellum, 142–43
flavescens, Perca, 86–88, 92, 162
flavigularis, Masticophis flagellum, 143
flavipunctatus, Pristurus, 11
  Pristurus flavipunctatus, 11
flaviventris, Coluber constrtictor, 142
flavus, Noturus, 162–63
Floridichthys, 73
florulentus, Platyceps, 144
fontinalis, Salmo, 258
  Salvelinus, 258
  Salvelinus fontinalis, 86–88, 162
formosa, Heterandria, 218
Forsythia, 131
fossilis, Cobitus, 34
  Misgurnus, 34
frenatus, Coluber flagellum, 147
frontalis, Notoropis cornutus, 163
fuliginosus, Cyclorhamphus, 230
Fundulus, 222, 224
  diaphanus diaphanus, 86–87
    menona, 163
  dispar dispar, 162
  lima, 52
  notatus notatus, 163
  parvipinnis, 51–52
    brevis, 52
    parvipinnis, 52
fusca, Apogon, 217
fuscus, Desmognathus fuscus, 192
fuscus, Eleutherodactylus, **235**

gadovi, Uta, 106
gairdnerii, Salmo gairdnerii, 164
Gambusia, 218
Gastrophryne carolinensis, 59
Gecko marginatus, 192
Gehyra oceanica, 59
gemmistratus, Imantodes, 250
gemonensis, Zamenis, 143
geographica, Graptemys, 21
Gerrhonotus multicarinatus, 194
gibbosus, Lepomis, 86–88, 162–63
Gila orcutti, 51
  purpurea, 253
girardi, Masticophis taeniatus, 143
Girella nigricans, 130
  simplicidens, 130
glaga, Apogonichthys, 218
glanis, Silurus, 34
globosa, Stegopa, 212
Gnamptogenys, 121
gouldii, Varanus, 56
grabhami, Eleutherodactylus, 239
Grammatocynus, 50
grandis, Acanthodactylus, 13
granulosus, Cyclorhamphus, 231
  Triturus granulosus, 251
Graptemys geographica, 21
grex, Xyne, 134
griseus, Lutianus, 212–14
Gryposuchus, 123
gulella, Hamacreadium, 212
guttatus, Ptyodactylus, 11
guttulata, Eremias, 14
guweirensis, Pristurus flavipunctatus, 11
Gymneleotris seminuda, 130
Gyretes centralis, 121
gyrinus, Schilbeodes, 163

Hadropterus maculatus, 162–63
Haemorrhois, 144
  hippocrepis, 144
Haldea valeriae valeriae, 252
Haloxylon, 10
Hamacreadium gulella, 212
  mutabile, 212
Hampala lopezi, 258
  macrolepidota, 258
hankinsoni, Hybognathus, 163
hardwickii, Lapemis, 156–59
Helicometrima nimia, 212
helleri, Xiphophorus helleri, 32
Hemidactylus turcicus, 11
heraldi, Mionurus, 216
Herpetodryas dipsas, 144
Hesperoleucus, 187, 253
  venustus, 187
Heterandria, 219
  formosa, 218
Heterodon contortrix, 193
  simus, 193
heterodon, Notropis, 162
heterolepis, Notropis heterolepis, 163
hippocrepis, Haemorrhois, 144
Holbrookia elegans thermophila, 250
holbrookii, Lampropeltis getulus, 39
horridus, Crotalus, 251
  Crotalus horridus, 251
hudsonicus, Salvelinus fontinalis, 258
huguenini, Puntius, 260
humilis, Lepomis, 162
Huro salmoides, 86, 92, 132, 162–63
Hybognathus hankinsoni, 163
Hyborhynchus notatus, 163
Hydrophis, 156
  brookii, 156–59
  cyanocinctus, 156–59
  fasciatus, 157–59
    atriceps, 156
Hydrous triangularis, 76
Hyla, 227, 248–49
  albofrenata, 226
  albosignata, 226
  andersonii, 246–48
  aurea, 122
  cinerea, 248
    cinerea, 59
  crucifer, 248
  lichenata, 234
  regilla, 252
  septentrionalis brunnea, 234
  versicolor, 248
  wilderi, 248
Hypentelium nigricans, 163
hypochondrialis, Phyllomedusa, 229
Hypostomus, 60
hypselonotus, Apogon, 217
Hypsiglena ochrorhynchus, 147

Ictalurus lacustris punctatus, 35–36, 39
Ictiobus, 37
  bubalus, 35, 37–38
  niger, 37–38
Imantodes gemmistratus, 250
  latistratus, 250
incisa, Microcotyle, 212
inconstans, Eucalia, 92, 162
indicus, Varanus, 56
inornata, Uma, 128
insculpta, Clemmys, 196
irideus, Salmo gairdnerii, 86

jamaicensis, Eleutherodactylus, 240
jocu, Lutianus, 212–13
jordani, Anoptichthys, 26–28, 82
jugularis, Zamenis, 143
  Zamenis jugularis, 143

karelinii, Coluber, 144
kiensis, Apogon, 217

Labidesthes sicculus sicculus, 162–63
Lacerta laevis, 12
lacinatus, Cyprinodon, 70, 72
laeta, Elaphe, 110
laevigatus, Lagcocephalus, 214
laevis, Lacerta, 12
  Ooeidozyga, 148–49
Lagcocephalus laevigatus, 214
Lampropeltis, 58
  getulus californiae, 147
    holbrookii, 39
lanei, Phyllodactylus, 250

Lapemis hardwickii, 156–59
lateralis, Coluber, 111
  Masticophis, 143
  Uta ornata, 97, 99–102, 104–105, 107
lathami, Trachurus, 205–10
latistratus, Imantodes, 250
Lebistes, 218–19
Lechradena edentula, 212
lecontei, Rhinocheilus, 147
  Rhinocheilus lecontei, 146
Leiolopisma noctua, 59
  unicolor, 59
Lepidodactylus lugubris, 59
Lepisosteus osseus oxyurus, 162
Lepomis aurtius, 86–87
  cyanellus, 163
  gibbosus, 86–88, 162–63
  humilis, 162
  macrochirus macrochirus, 92, 162–63
  megalotis peltastes, 162
  salmoides, 86
leptachanthus, Apogon, 217
Leptodactylus, 230
Leptodeira annulata polysticta, 114, 250
Leptogenys, 121
Leptothyphlops philippsi, 10, 14
lethostigma, Pseudopleuronectes, 254
Leucosomus corporalis, 86–88
leucurus, Citellus, 242
Leurodera decora, 212
Leurognathus, 125
lewisi, Eleutherodactylus, 236
Lichanura, 58
lichenata, Hyla, 234
limi, Fundulus, 52
limi, Umbra, 92, 162–63
linearis, Atriplex, 75
  Uta ornata, 101–102, 107
lineatulus, Masticophis flagellum, 143
lineolatus, Catonotus, 163
Liopelma, 148
Liophis, 18
lopesi, Trigodonops, 123
lopezi, Hampala, 258
Lota lota maculosa, 86, 88
lucasensis, Crotalus, 115, 117
lucifuga, Eurycea, 126
lucius, Esox, 86, 162
lugubris, Lepidodactylus, 59
luteiventris, Rana pretiosa, 252
luteolus, Eleutherodactylus, 236
Lutianus analis, 214
  aya, 214
  blackfordii, 213
  campechanus, 213
  griseus, 212–14
  jocu, 212–13
  synagris, 214
lutrensis, Notropis, 253

machrochirus, Lepomis machrochirus, 92, 162–63
macrolepidota, Hampala, 258
macularius, Cyprinodon, 72–73, 77
maculatus, Hadropterus, 162–63
  Platypoecilus, 218–20, 222–24
maculosa, Lota lota, 86, 88
Malaclemmys, 112
maniculatus, Peromyscus, 242
marginatus, Gecko, 192
marina, Trutta, 258
marinus, Bufo, 234
  Petromyzon, 86
martinicensis, Eleutherodactylus, 239–240
Masticophis, 141–42
  anthonyi, 143
  aurigulus, 143
  barbouri, 143
  bilineatus, 143
  flagellum flagellum, 142–43
    flavigularis, 143
    lineatulus, 143
    piceus, 143
  lateralis, 143
  mentovarious, 143
  ornatus, 142
  ortenburgeri, 143
  taeniatus australis, 143
    girardi, 143
    ruthveni, 143
    schotti, 143
    striolatus, 143
    taeniatus, 143
maxima, Bombina, 150
mearnsi, Notropis, 253
Megastomatobus, 37
  cyprinella, 35, 37–38
melanoleucus, Pituophis, 110
  Pituophis melanoleucus, 129
melanopleura, Doryramphus, 130
melanops, Minytrema, 35, 38
melas, Ameiurus melas, 35, 39, 86, 162–63
  Apogon, 217
meleagris, Rhinichthys atratulus, 163
menona, Fundulus diaphanus, 163
mentovarius, Masticophis, 143
meridionalis, Cottus, 42
Messor, 12
mexicana, Siredon, 151
mexicanus, Astyanax, 26–28, 82, 84
Microcotyle incisa, 212
microdon, Pristis, 46
Microperca microperca microperca, 163
microperca, Microperca microperca, 163
Micropogon undulatus, 52
Micropterus dolomieu dolomieu, 86, 163
microscutata, Uta, 106
Minytrema, 36
  melanops, 35, 38
Mionurus bombonensis, 217
  heraldi, 216
  mydrus, 217
mirabilis, Phenacobius, 163
Misgurnus fossilis, 34
mississippiensis, Alligator, 59
Monomorium, 121
montezumae, Xiphophorus, 31–32
monticello, Sterrhurus, 212
moodiei, Rana, 151
mormon, Coluber constrictor, 142
Morone americana, 86, 88
Mosasaurus, 124
Moxostoma, 36, 38
  anisurus, 35, 38, 162

aureolum, 35, 38, 162
duquesnii duquesnii, 162
erythrurum, 35–36, 38
mucosa, Rana boylii, 56
muhlenbergii, Clemmys, 197
multicarinatus, Gerrhonotus, 194
murphyi, Emoia, 59
mutabile, Hamacreadium, 212
mydrus, Mionurus, 217

najadum, Platyceps, 144
namaycush, Cristivomer namaycush, 253
nannomyzon, Catostomus catostomus, 86–88
naraharae, Pleurogobius, 132
Nasturtium, 51
natalis, Ameiurus natalis, 35, 39, 163
Ameiurus nebulosus, 34
natator, Staurois, 149
Natrix, 108, 250
cyclopion, 59
cyclopion, 59
sipedon confluens, 59
Naucrates, 209
nebulatus, Dromicus, 194
nebulosus, Ameiurus, 34
Ameiurus nebulosus, 86–88, 162
Anolis, 250
Necturus, 122
neivensis, Dinosuchus, 123
Nematobramis, 149
Neoponera, 121
Neostethus, 202
Neotoma, 242
nerka, Oncorhynchus, 170
Nesogrammus, 50
thompsoni, 50
nevadensis, Cyprinodon, 72–73, 77
niger, Esox, 86–88
Ictiobus, 37–38
nigra, Aniella, 2
Aniella pulchra, 2–6
Emoia, 59
nigricans, Girella, 130
Hypentelium, 163
nigricauda, Uta, 106
nigriceps, Tarbophis, 15
nigriventer, Discogiossus, 231, 232
nigromaculata, Rana, 248–49
nigro-maculatus, Pomoxis, 259
nigrum, Boleosoma nigrum, 163
nimia, Helicometrima, 212
Nocomis biguttatus, 163
noctua, Leiolopisma, 59
notatus, Fundulus notatus, 163
Hyborhynchus, 163
Notemigonus crysoleucas auratus, 35–36, 38, 163
crysoleucas, 86–88
Notropis, 253
anogenus, 162
atherinoides atherinoides, 162
bifrenatus, 86–88
cornutus chrysocephalus, 163
cornutus, 86–88
frontalis, 163
deliciosus stramineus, 163
heterodon, 162
heterolepis heterolepis, 163
hudsonius amarus, 86–87
lutrensis, 253
mearnsi, 253
rubellus, 162
spilopterus, 163
umbratilus cyanocephalus, 162–63
volucellus volucellus, 163
xaenocephalus richardsoni, 162
Noturus flavus, 162–63
nubicola, Eleutherodactylus, 238
nuntius, Crotalus viridis, 115, 117
Nuphar advena, 25
Nyphaea odorata, 25

obesus, Enneacanthus, 86, 88
Sauromalus, 193
oblongus, Erimyzon oblongus, 86–88
occidentalis, Allenrolfea, 75
Arizona elegans, 145, 147, 196
oceanica, Gehyra, 59
ocellatus, Chalcides, 14
ochrorhyncha, Hypsiglena, 147
Odontomachus, 121
Odontophrynus, 230
odorata, Nymphaea, 25
odoratus, Sternotherus, 21, 196
Oligoplites, 209
olmstedi, Boleosoma nigrum, 86–87
olympicus, Rhyacotriton, 125
omiscomaycus, Percopsis, 86, 88
Onocorhynchus nerka, 170
tschawytscha, 164, 168, 190
Oniscus, 146
Oocormus, 227–30
microps, 225–26, 228–30
Ooeidozyga, 148–49
laevis, 148–49
Ophiops elegans, 10
elegans, 14
Opisthonema, 134
Opuntia, 242
orcutti, Eleutherodactylus, 241
orcuttii, Gila, 51
oreganus, Crotalus viridis, 58, 115, 117–18, 147, 250
orientalis, Bombina, 150
ornata, Uta, 97, 100, 106
ornatus, Masticophis, 142
ortenburgeri, Masticophis, 143
oxyrhynchus, Acipenser sturio, 86
oxyurus, Lepisosteus osseus, 162

Pachycondyla, 121
pallida, Agama ruderata, 10, 12
palometa, Trachinotus, 208
pantoni, Eleutherodactylus, 235–38
Paralichthys lethostigma, 254
Paramecium, 62
Paraponera, 121
clavata, 121
pardalis, Acanthodactylus pardalis, 13
parietalis, Thamnophis sirtalis, 127
pavimentatus, Eumeces schneideri, 14
parvipinnis, Fundulus, 51–52
Fundulus parvipinnis, 52

parvulus, Eumeces, 250
Zachaenus, 228, 230
pectinatus, Pristis, 43–46
pelagicus, Alopias, 55
peltastes, Lepomis megalotis, 162
Perca flavescens, 86–88, 92, 162
Percina caprodes caprodes, 162
semifasciata, 162
Percopsis omiscomaycus, 86, 88
Periops, 144
algirus, 144
dovii, 144
Peromyscus, 58, 61
maniculatus, 242
perotteti, Pristis, 43–46
Petromyzon marinus, 86
Phallostethus, 202
Pheidole, 121
Phenocobius mirabilis, 163
philippsi, Leptotyphlops, 10, 14
Phoberomys, 123
Phyllodactylus lanei, 250
Phyllomedusa hypochondrialis, 229
piceus, Masticophis flagellum, 143
picta, Chrysemys, 196
pictus, Discoglossus, 231
Discoglossus pictus, 233
Eleotris, 130
pinderi, Cyclorhamphus, 230
pipiens, Rana, 122, 246
piscivorus, Agkistrodon, 59
Pituophis, 58, 110
catenifer annectens, 109
catenifer, 145, 147
melanoleucus, 110
melanoleucus, 129
Platurus, 192
Platyceps, 143
florulentus, 144
najadum, 144
ravergieri, 144
rhodorachis, 144
rogersi, 144
ventromaculatus, 143–44
Platypoecilus, 31, 219, 222
couchianus, 219
maculatus, 218–20, 222–24
variatus, 31, 219
xiphidium, 31, 219
Platyurus, 192
platyurus, Cosymbotus, 192
Stellio, 192
Plectostomus, 60
Pleurogobius, 132
boulengeri, 132
naraharae, 132
plumbeus, Couesius plumbeus, 86, 88
Poeciliapsis, 219
Poecilichthys caeruleus caeruleus, 163
exilis, 162
spectabilis spectabilis, 163
zonalis zonalis, 162–63
Poeciliopsis, 253
poecilopterus, Apogonichthys, 218
polysticta, Leptodeira annulata, 114, 250
Pomoxis annularis, 162, 259
nigro-maculatus, 86, 162, 259
pretiosa, Rana pretiosa, 252
priapus, Coluber constrictor, 142
Pristis, 43
antiquorum, 43, 46
microdon, 46
pectinatus, 43–46
perotteti, 43–46
Pristurus flavipunctatus, 11
flavipunctatus, 11
guweirensis, 11
rupestris, 11
profundus, Alopias, 55
proximus, Thamnophis sauritus, 59
Psammophis sibilans schokari, 15
Psathyrotes ramosissima, 75
Pseudemys, 7
scripta troostii, 59, 249
troostii, 7, 9
Pseudogramma thaumasium, 130
Pseudomyrma, 121
Pseudopleuronectes americanus, 254
Pterogobius, 132
boulengeri, 132
Pteroplatea, 134
pterurus, Strongylura, 130
Ptyodactylus hasselquistii guttatus, 11
pulchra, Aniella, 2
Aniella pulchra, 2–6, 146
pullum, Campostoma anomalum, 163
punctatus, Ictalurus lacustris, 35–36, 39
Puntius huguenini, 258
purpurea, Gila, 253
Purussaurus, 123–24
brasiliensis, 123–24
pygmaeus, Xiphophorus, 31, 32

quadrimaculatus, Anopheles, 126
quadrivittata, Elaphe quadrivittata, 111
Quintana atrizona, 218

radix, Thamnophis, 127
Raia stellaris, 133
texana, 133
ramosissima, Psathyrotes, 75
Rana, 248
acanthi, 149
boylii boylii, 56, 126
mucosa, 56
catesbeiana, 19, 59, 122
clamitans, 59
esculenta, 19
moodiei, 151
nigromaculata, 248–49
pipiens, 122, 246
pretiosa luteiventris, 252
pretiosa, 252
sphenocephala, 59
temporaria, 19
tigrina, 19
Rasbora, 149
ravergieri, Platyceps, 144
regilla, Hyla, 252
Rhamphastomopsis, 124
Rhinichthys, 187–88
atratulus atratulus, 86–88
meleagris, 163
cataractae, 86–88

osculus robustus, 187–88
Rhinocheilus, 58, 146–47
lecontei, 147
lecontei, 146
Rhodeus amarus, 183–85
rhodorachis, Platyceps, 144
rhombeatus, Causus, 114
Rhomboplites aurorubens, 214
Rhyacotriton, 125
olympicus, 125
Rhytina, 138
richardsoni, Notropis xaenocephalus, 162
ricordii, Eleutherodactylus, 239
robustus, Acanthodactylus, 14
Rhinichthys osculus, 187–88
rogersi, Platyceps, 144
rubellus, Notropis, 162
ruber, Crotalus, 108, 111, 115, 117, 242
ruberrimus, Anoptichthys, 83
rubrofluviatilus, Cyprinodon bovinus, 70
ruderata, Agama, 12
Agama ruderata, 12
rupestris, Ambloplites, 132
Ambloplites rupestris, 86, 162
Pristurus, 11
Pristurus flavipunctatus, 11
ruthveni, Masticophis, 143
Rutilus rutilus, 34
rutilus, Rutilus, 34
Ruvettus, 50

saira, Cololabis, 171, 173, 175–76, 178–79
salar, Salmo, 257
Salmo salar, 86
Salicornia, 75
salinus, Cyprinodon, **69,** 70–74, 76–77
Salmo albus, 258
argentinus, 258
fario, 166
fontinalis, 258
gairdnerii gairdnerii, 164
irideus, 86
salar, 257
salar, 86
trutta, 258
fario, 86, 90
salmoides, Huro, 86, 92, 132, 162–63
Lepomis, 86
salvator, Varanus, 56
Salvelinus fontinalis, 258
fontinalis, 86–88, 162
hudsonicus, 258
samoensis, Emoia, 59
sapidissima, Alosa, 86
sardus, Discoglossus pictus, 233
Sauromalus obesus, 193
Scaphiopus couchii, 128
Sceloporus, 147
undulatus undulatus, 196
Schilbeodes gyrinus, 163
schistosa, Enhydrina, 156–59
schokari, Psammophis sibilans, 15
schotti, Masticophis taeniatus, 143
Uta ornata, 97, 100, 102, 104, 107
Scincus scincus, 14
scincus, Scincus, 14
Scomber scombrus, 208
Scomberesox, 182
Scomberoides, 209
scombrus, Scomber, 208
scutellatus, Acanthodactylus scutellatus, 13
Selene, 209
semifasciata, Percina caprodes, 162
seminuda, Gymneleotris, 130
semiscaber, Cottus, 41–42
Semotilus atromaculatus atromaculatus, 86–88, 163
Sericomyrmex amabilis, 121
Seriola, 207, 209
serpentina, Chelydra, 21, 196
Chelydra serpentina, 59
Serrasalmo, 84
sicculus, Labidesthes sicculus, 162–63
Silurus glanis, 34
simonii, Typhlops, 14
simplicidens, Girella, 130
simus, Heterodon, 193
sinaita, Agama mutabilis, 11
Siphateles, 69
Siredon mexicana, 151
sirtalis, Thamnophis sirtalis, 127
skiltonianus, Eumeces skiltonianus, 58
socialis, Udonella, 212
socotrae, Zamenis, 143
Solenopsis, 121
Spalerosophis, 142
spectabilis, Poecilichthys spectabilis, 163
sphenocephala, Rana, 59
spicata, Distichlis, 75
spilopterus, Notropis, 163
spinalis, Coluber, 142
spinifera, Amyda spinifera, 21
Squalus acanthias, 188–89
sucklii, 188
Staurois natator, 149
Stegopa globosa, 212
stejnegeri, Uta stansburiana, 107
stejnegerianus, Coluber constrictor, 142
stellaris, Raia, 133
Stellio platyurus, 192
stellio, Agama, 12
Agama stellio, 12
Stenodactylus elegans, 10
Stephanocasmus casus, 212
Sternotherus odoratus, 21, 196
Sterrhurus monticello, 212
steudneri, Tropiocolotes, 10–11
Stizostedion vitreum vitreum, 86, 88
Strongylura pterurus, 130
Storeria dekayi, 59, 252
storeyae, Enneaptergius, 131
stramineus, Notropis deliciosus, 163
striatus, Apogonichthys, 218
strigatus, Xiphophorus helleri, 32
striolatus, Masticophis taeniatus, 143
Suaeda, 10
subsalsum, Ambystoma, **152,** 153
subulatus, Chilodipterus, 217
sucklii, Squalus, 188
synagris, Lutianus, 214
syriacus, Acanthodactylus schreiberi, 13

tabira, Acheilognathus, 183–84, 186
taeniatus, Masticophis taeniatus, 143
Tarbophis nigriceps, 15
temporaria, Rana, 19
Terrapene carolina, 112, 196
terrestris, Bufo, 193
terror, Dinosuchus, 123–24
texana, Raia, 133
Thalassophina viperina, 156
Thalassophis, 156, 158
  anomalus, 156–59
Thamnophis, 108, 250
  radix, 127
  sauritus proximus, 59
  sirtalis parietalis, 127
    sirtalis, 127
thaumasium, Pseudogramma, 130
thermophila, Holbrookia elegans, 250
Thomomys bottae bottae, 194
thompsoni, Nesogrammus, 50
Thoropa, 230
  miliaris, 230
tigrina, Rana, 19
Trachinotus culveri, 209
  falcatus, 209
  palometa, 208
Trachurus, 205–206
  lathami, 205–10
  picturatus binghami, 205
  trachurus, 205
trachurus, Trachurus, 205
triangularis, Hydrous, 76
Trigodonops lopesi, 123
triostegus, Acanthurus, 130
tristrami, Acanthodactylus, 12
Triturus granulosus granulosus, 251
troostii, Pseudemys, 7, 9
  Pseudemys scripta, 59, 249
Tropiocolotes steudneri, 10, 11
truei, Ascaphus, 125–27
Trutta Argentina, 258
  marina, 258
trutta, Salmo, 258
tschawytscha, Oncorhynchus, 164, 168, 190
tuberculata, Uta bicarinata, 104–106
tuberculatum, Ectatomma, 121
turcicus, Hemidactylus, 11
tutuilae, Fagasa, 133
Tylosurus, 171, 182
Typhlomolge, 140
Typhlops simonii, 14
Typhlotriton, 140

Udonella socialis, 212
Uma inornata, 128
Umbra limi, 92, 162–63
undulatus, Micropogon, 52
  Sceloporus undulatus, 196
unica, Uta, 106
unicolor, Leiolopisma, 59
Urosaurus, 104, 106
urospilus, Coryphoterus, 130
Uta, 97, 105–107, 147
  bicarinata, 99–100
    tuberculata, 104–106
  gadovii, 106
  microscutata, 106
  nigricauda, 106
  ornata, 97, 100, 106
    lateralis, 97, 99–102, 104–105, 107
    linearis, 101–102, 107
    schottii, 97, 100, 102, 104, 107
  stansburiana stejnegeri, 107
  unica, 106

valeriae, Haldea valeriae, 252
  Virginia, 252
valliceps, Bufo, 59
Varanus, 56
  gouldii, 56
  indicus, 56
  salvator, 56
variatus, Platypoecilus, 31, 219
variegata, Bombina, 150
variegatus, Coleonyx, 196
velifer, Carpiodes, 35, 38
ventromaculatus, Coluber, 143
  Platyceps, 143–44
venustus, Hesperoleucus, 187
vermiculatus, Esox, 131, 163
versicolor, Hyla, 248
Virginia, 252
  valeriae, 252
viridiflavus, Zamenis viridiflavus, 143
viridis, Crotalus viridis, 15, 115, 117–18
vitreum, Stizostedion vitreum, 86, 88
volucellus, Notropis volucellus, 163
Vomer, 209
vulpina, Elaphe vulpina, 250
vulpinus, Alopias, 55

wilderi, Hyla, 234
wilsoniana, Chamaecyparis, 125

Xenogramma, 50
  carinatum, 50
xiphidium, Platypoecilus, 31, 219
Xiphophorus, 31–32, 221
  helleri brevis, 32
    helleri, 32
    strigatus, 32
Xyne grex, 134

Zachaenus, 230
  parvulus, 228, 230
Zamenis, 141, 143
  dahlii, 143
  gemonensis, 143
  jugularis, 143
    asianus, 143
    caspius, 143
    jugularis, 143
  socotrae, 143
  viridiflavus carbonarius, 143
    viridiflavus, 143
zonalis, Poecilichthys zonalis, 162–63

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